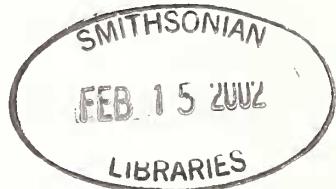




# Redescription of *Oxychilus meridionalis* (Paulucci, 1881) (Pulmonata: Zonitidae)

Giuseppe Manganelli & Folco Giusti



**KEY WORDS:** Gastropoda, Pulmonata, Zonitidae, *Oxychilus*, *O. meridionalis* (Paulucci, 1881), redescription, taxonomy, nomenclature, distribution, conservation, Italy.

## ABSTRACT

*Oxychilus meridionalis* (Paulucci, 1881) belongs to *Oxychilus* (s.str.) sensu Giusti & Manganelli (1999), a "subgenus" of *Oxychilus* characterized by: penis with flagellum (1); penial retractor inserted at apex of flagellum (2); epiphallus usually longer than proximal penis, its internal wall with slender longitudinal pleats (3); mucous gland mainly vaginal (4); long mesocone of central tooth (5). It is a small to medium-sized species, with a yellowish, yellow – brown or greenish shell, very variable in shape and size. It can only be identified by anatomical characters: penis without clear distinction into proximal and distal parts ("bottle-neck" portion of proximal penis absent) (1); distinctive internal ornamentation of penis consisting of 5-6 to 13-15 longitudinal pleats, usually straight, sometimes wavy or lobate except around epiphallus opening into penis where there is a system of smaller pleats, radially disposed, sometimes fragmented into rows of variably large papillae (2).

*O. meridionalis* has a very puzzling nomenclatural-taxonomical history due to its wide conchological and anatomical variability not realized by early authors. Consequently it has been reported in the literature under many different names, three of which are its junior synonyms: *Hyalinia isseliana* Paulucci, *Oxychilus tongiorgii* Giusti, 1969, and *O. forcadianus* Giusti, 1969. Other names recently erroneously used for this species include: "*Oxychilus obscuratus*", "*O. porroi*", "*O. alliarius*", "*O. cf. draparnaudi*" and "*O. (cfr.) uziellii*" (FORCART, 1967, 1968; GIUSTI, 1969b; GIUSTI & MAZZINI, 1971; SABELLI *et al.*, 1977).

*O. meridionalis* is not globally threatened. It has a narrow distribution, limited to Tuscany and eastern Liguria, but does not seem to be under any particular threat at present.

## RIASSUNTO

*Oxychilus meridionalis* (Paulucci, 1881) appartiene ad *Oxychilus* (s.str.) sensu Giusti & Manganelli (1999), un "sottogenere" di *Oxychilus* caratterizzato da: presenza del flagello peniale (1); retrattore peniale inserito all'apice del flagello (2); epifallo generalmente più lungo del pene prossimale e con le pareti interne percorse solo da esili pliche longitudinali (3); ghiandola mucosa per lo più vaginale (4); dente centrale della radula con lungo mesocono (5). *O. meridionalis* è una specie di dimensioni piccole – medie, con conchiglia giallognola, talvolta giallo – bruna o verdastra, molto variabile in forma e dimensioni che può essere identificata solo con lo studio anatomico: pene privo di evidente restrimento ("collo di bottiglia") alla fine della porzione prossimale (1); ornamentazione interna del pene prossimale costituita da 5-6 a 13-15 pliche longitudinali, generalmente diritte, qualche volta ondulate o lobate eccetto che attorno all'apertura dell'epifallo dove esiste un sistema di pliche più piccole disposte radialmente e talvolta frammentate in file di più o meno grandi ed evidenti papille (2).

*O. meridionalis* ha una storia nomenclaturistica e tassonomica molto complessa a causa del fatto che la sua ampia variabilità, conchiliare ed anatomica, non è stata correttamente interpretata dagli autori del passato. Conseguentemente, è stato citato nella letteratura sotto molti differenti nomi, tre dei quali risultano più giovani sinonimi: *Hyalinia isseliana* Paulucci, *Oxychilus tongiorgii* Giusti, 1969, e *O. forcadianus* Giusti, 1969. Altri nomi applicati erroneamente a questa specie in tempi recenti sono: "*Oxychilus obscuratus*", "*O. porroi*", "*O. alliarius*", "*O. cf. draparnaudi*" e "*O. (cfr.) uziellii*" (FORCART, 1967, 1968; GIUSTI, 1969b; GIUSTI & MAZZINI, 1971; SABELLI *et al.*, 1977).

*O. meridionalis* ha una distribuzione ristretta, circoscritta alla Toscana ed alla Liguria orientale e non sembra essere, al presente, soggetto ad alcuna particolare minaccia.

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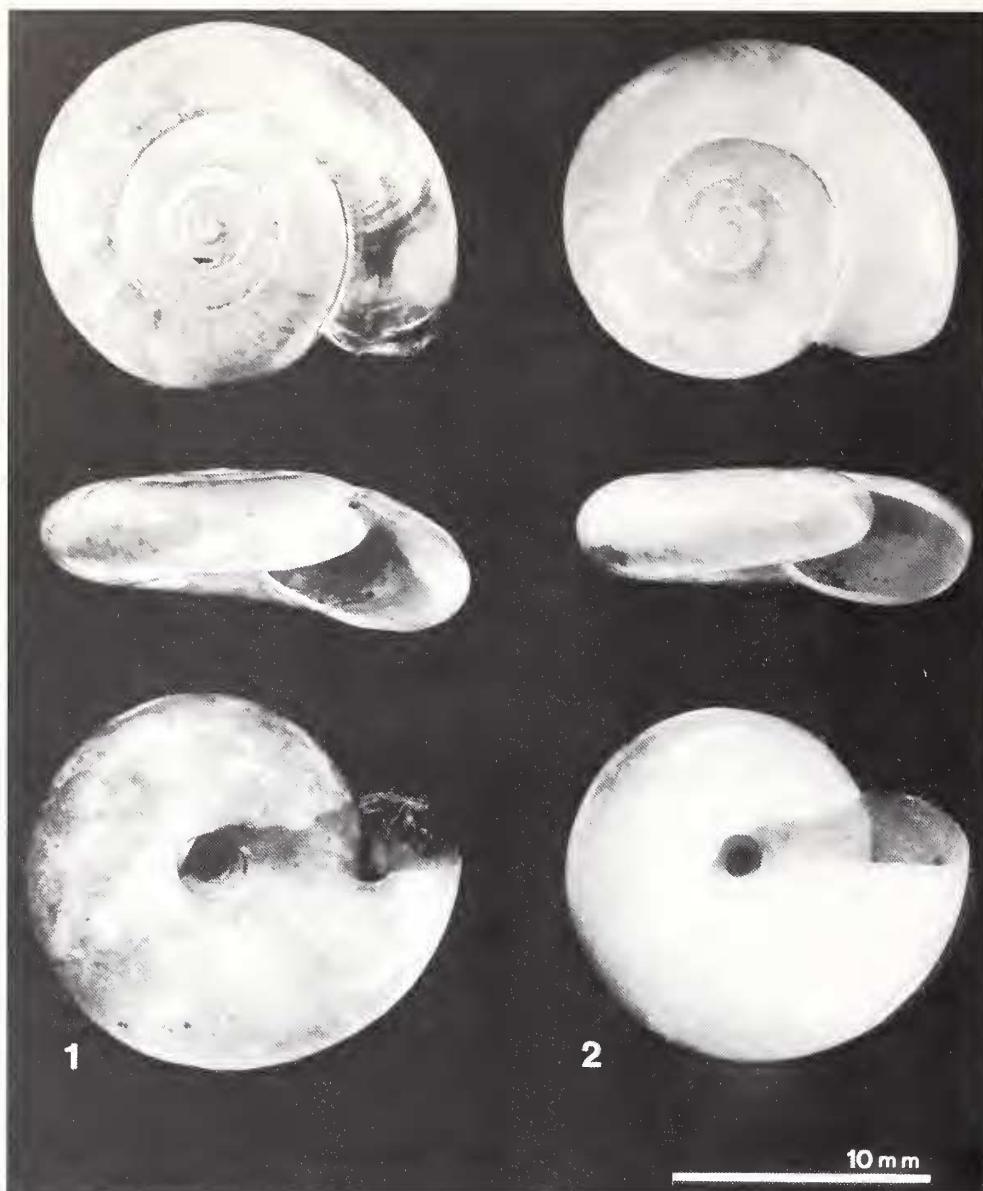
## INTRODUCTION

Most of the *Oxychilus* taxa of the species group described from Tuscany in the 19<sup>th</sup> century by ISSEL (1872), DE STEFANI (1879, 1883-88), PAULUCCI (1881, 1882, 1886), and WESTERLUND (1886) were unrevised until recently (cf. ALZONA, 1971).

In late 1950s, L. Forcart published a thorough survey of the Palaearctic zonitid snails in which he proposed a new classification (FORCART, 1957, 1959, 1960) and demonstrated that anatomical study was necessary for correct classification of the oxychiline zonitids. He, subsequently, published two papers on Tuscan *Oxychilus*. In the first he described a new species and revised some classic *Oxychilus* taxa (FORCART, 1967); in the second, devoted to some new field collections, he recorded for Tuscany (Tuscan Archipelago excluded) eight species: *O. (Ortizius) lanzai* n. sp., *O. (Ortizius) obscuratus* (Villa & Villa, 1841), *O. (Ortizius) porroi* (Paulucci, 1882), *O. (Oxychilus) paulucciae* (De Stefani, 1883), *O. (Oxychilus) meridionalis* (Paulucci, 1881), *O.*

(*Oxychilus*) *isselianus* (Paulucci, 1882), *O. (Oxychilus) draparnaudi* (Beck, 1837) and *O. (Oxychilus) cellarinus* (Müller, 1774) (FORCART, 1968). Three other species, *O. (Ortizius) tongiorgii* Giusti, 1969, *O. (Ortizius) forcadianus* Giusti, 1969, and *O. (Ortizius) alliarius* (Miller, 1822) were added a year later by one of us (FG), bringing the number of the *Oxychilus* species in inland Tuscany to eleven (GIUSTI, 1969a, 1969b).

In the late 1960s, one of us (FG) was involved in studying the malacofauna of the Apuan Alps as a part of a project promoted by the Società Italiana di Biogeografia. He collected much new material and revised the material studied by L. FORCART (1967, 1968). It emerged that Forcart, who studied genital anatomy using diaphanized preparations of the whole distal genitalia, evidently did not realize the enormous variation in internal structure of the proximal penis and flagellum, and since he based his revision on the study of non-topotypical specimens, he misinterpreted some classic species. At this point, GIUSTI &



Figs. 1-2. Shells of *Oxychilus meridionalis* (Paulucci, 1881) from Fabbriche di Bagni di Lucca (Bagni di Lucca, LU), 32TPP3175, M. Paulucci leg. 9.1877. Lectotype of *Hyalinia meridionalis* (Paulucci collection, Museo Zoologico "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze, MZUF no. 13187; Fig. 1) and lectotype of *Hydmania isseliana* Paulucci, 1882 (Paulucci collection, Museo Zoologico "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze, MZUF no. 687; Fig. 2).

MAZZINI (1971) stated that it was necessary to shelve everything and start again.

As a first contribution to the revision of the Tuscan *Oxychilus* species we tackled revision of the oldest established species: *Zonites uziellii* Issel, 1872, (MANGANELLI & GIUSTI, 1985, 1993, 2000). After long preparatory work, we have now revised the most puzzling species: *Hyalinia meridionalis* Paulucci, 1881.

*Oxychilus meridionalis* (Paulucci, 1881) - Checklist Fauna d'Italia code number: 16.085.0.009.0.

*Hyalinia meridionalis* PAULUCCI, 1881: 78-79, Pl. 1, fig. 6; PAULUCCI, 1882: Pl. 9, fig. 12.

Type material: in the Paulucci collection there are nine lots of *Hyalinia meridionalis*: one from San Marino, G. Cavanna leg. 7.1878 (MZUF 829/1), one from Avellana, G. Cavanna leg. 1878 (MZUF 830/3), two from Monte Cassino, C. Caroti & M. Paulucci leg. 4.1877 (MZUF 781/12), G. Cavanna leg. 6.1879 (MZUF 832/2), two from Bagni di Lucca, Miss Jones & Mr. Paget leg. 1877 (MZUF 828/7, 13188/5), one from Fabbriche presso i Bagni di Lucca, M. Paulucci leg. 1877 (MZUF 13187/1), one from Camaldoli, C. Caroti leg. 1876 (MZUF



831/1) and one from Palermo, L. Benoit leg. 1877 (MZUF 833/1). All of them, except the latter two (MZUF 831, 833) are from localities listed by PAULUCCI (1881). FORCART (1967) selected MZUF 13187 as the lectotype, possibly because it is the only one which matches the Paulucci's figure (Pl. 1, fig. 6). As for the other type material, only MZUF 828/7, 13188/5 and 831/1 are from localities where *O. meridionalis* lives. Therefore remaining material (MZUF 829/1, 830/3, 781/12, 832/2 and 833/1) belongs to other species.

Type locality: "Abita S. Marino, Avellana nell'Umbria (1878), Monte Cassino in Terra di Lavoro (1879). Già anteriormente io conoscevo questa specie dei Bagni di Lucca, e di Monte Cassino, ove Caroti ed io l'avevamo raccolta nel 1877. Il mio tipo è di Bagni di Lucca perché di questa località dispongo di un più ricco materiale". Following the designation of the lectotype, the type locality becomes "Fabbriche presso i Bagni di Lucca".

*Hyalinia Isseliana* PAULUCCI, 1882: 165-168, Pl. 9, fig. 13.

Type material: the type series of *Hyalinia isseliana* probably consists of three lots (MZUF 687/1, 688/3, 13346/1). Two of them (MZUF 687, 688) contain an anonymous handwritten label which reads: "Hyalina Isseliana Paulucci Fabbriche presso i Bagni di Lucca (Lucca; Toscana) Settembre 1877". MZUF 687 contains three other labels: one by M. Paulucci "H. Isseliana Paulucci. Fabbriche Pr. de Lucques", one by L. Forcart with "Lectotype of *Oxychilus (Oxychilus) isselianus* (Paulucci)" and another by A. Riedel. Likewise, MZUF 688 contains three other labels: one by L. Forcart, "Paralectotypes of *Oxychilus (Oxychilus) isselianus* (Paulucci)" and the other two by F. Giusti and A. Riedel respectively. MZUF 13346 contains four labels: one by L. Forcart (though not signed), "Lectotypus von *Hyalinia isseliana* Paulucci, 1882 ...", one with "Coll. Mus. Firenze 687" written along an edge, one by F. Giusti and two by A. Riedel. In our opinion, these five specimens belong to a same lot, collected at Fabbriche near Bagni di Lucca by M. Paulucci in September 1877. This lot was probably later divided into two (MZUF 687 + 13346 and 688) and a new label with the original data added. Subsequently one specimen of MZUF 687 + 13346 was designated as lectotype by L. Forcart. Forcart added a first label "Lectotypus von *Hyalinia isseliana...*" remarking "synonym mit *Oxychilus (Oxychilus) meridionalis* (Paulucci)". He subsequently changed his mind, cancelling the note on synonymy and adding a new label "Lectotype of *Oxychilus (Oxychilus) isselianus* (Paulucci)". At this point someone has put one of these two specimens and Forcart's first label in a different box, which was later numbered MZUF 13346. This may explain why there are apparently two lectotypes of *Hyalinia isseliana*. The lectotype designated by L. Forcart is easily recognized as MZUF 687.

Type locality: "Questa specie è molto sparsa in tutta l'Italia centrale e meridionale, conservo bensì per tipo della nuova *Hyalinia* la forma che si rinviene nei dintorni dei Bagni di Lucca ove si potrebbe dire che trovasi il suo centro di sviluppo. La conchiglia figurata proviene infatti da una località denominata le Fabbriche, a poca distanza dai Bagni".

*Oxychilus (Ortizius) obscuratus*, FORCART, 1967: 116-117, Fig.

2, Pl. 7, fig. 2, non Villa & Villa, 1841.

*Oxychilus (Ortizius) porroi*, FORCART, 1967: 117 partim, non Paulucci, 1882.

*Oxychilus (Ortizius) obscuratus*, FORCART, 1968: 87 partim [NMB 5894-a], non Villa & Villa, 1841.

*Oxychilus (Ortizius) porroi*, FORCART, 1968: 87 [MZUF no number], non Paulucci, 1882.

*Oxychilus (Oxychilus) meridionalis*, FORCART, 1968: 87 partim [MZUF 6971].

*Oxychilus (Ortizius) tongiorgii* GIUSTI, 1969a: 367-369, Figs. 1-2, 5A, Pl. 1, figs. 1-2.

Type material: the holotype and 9 paratypes are in the Giusti collection at the Dipartimento di Biologia Evolutiva, Università di Siena (Italy).

Type locality: "Grotta dei Ladri (n. 262 T. Pi) Monti Pisani nei pressi di Asciano".

*Oxychilus (Ortizius) forcartianus* GIUSTI, 1969a: 369-371, Figs. 3-4, 5B, Pl. 1, figs. 3-4.

Type material: the holotype and 3 paratypes are in the Giusti collection at the Dipartimento di Biologia Evolutiva, Università di Siena (Italy).

Type locality: "Grotta dei Fiorentini presso Pomarance (Grosseto)".

*Oxychilus (Ortizius) alliarius*, GIUSTI, 1969b: Figs. 1-2, Pl. 1, figs. 1-3, non Miller, 1822.

*Oxychilus* (s.str.) cf. *meridionalis*, GIUSTI & MAZZINI, 1971: 261-262.

*Oxychilus* (s.str.) cf. *draparnaudi*, GIUSTI & MAZZINI, 1971: 262-263, non Beck, 1837.

*Oxychilus* (cfr.) *uzzielli* [sic], SABELLI et al., 1977: 121-122, Fig. 1, Pl. 2, figs. 3a-3d, non Issel, 1872.

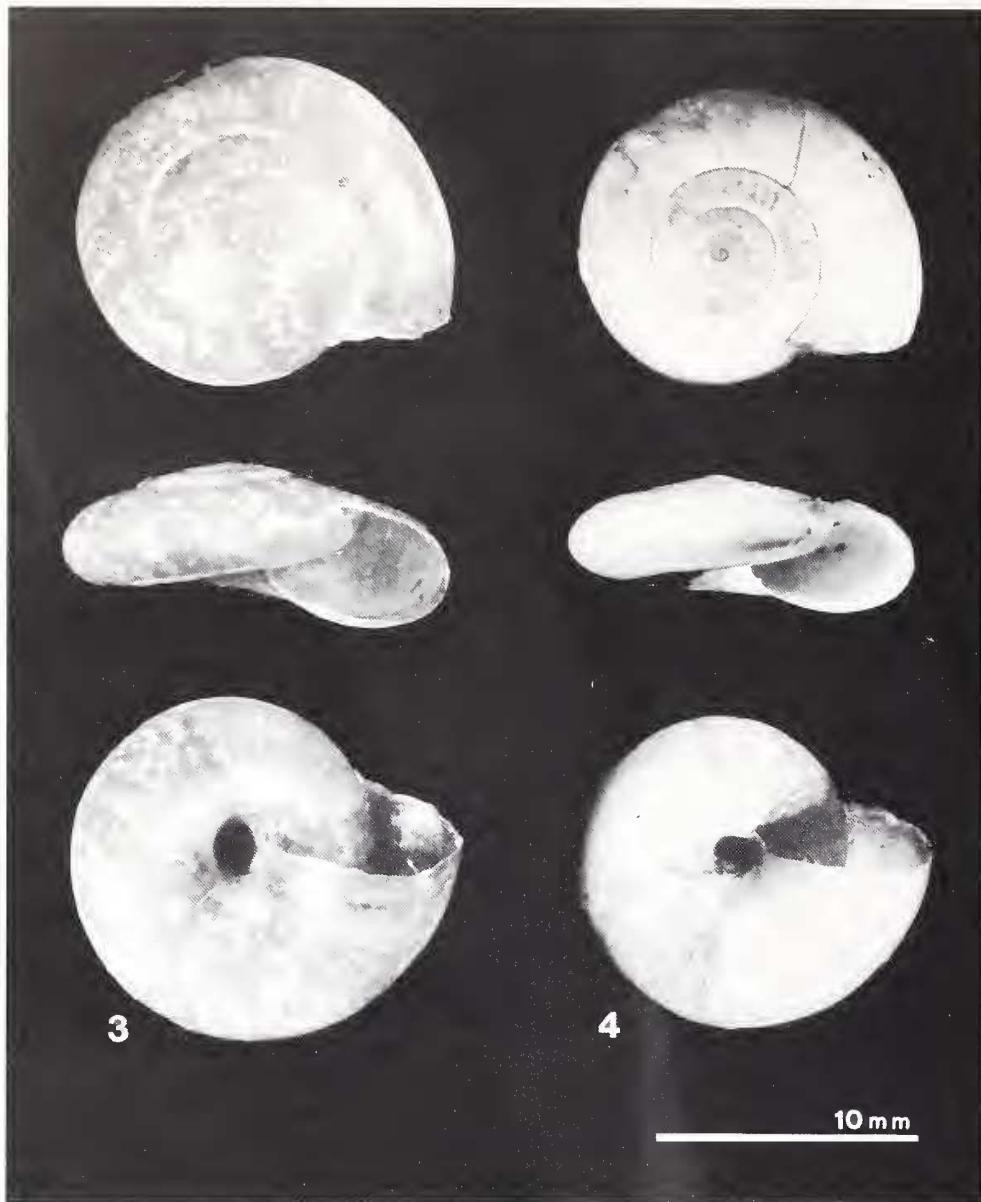
## IDENTIFICATION

A small to medium species of *Oxychilus* (s.str.) sensu GIUSTI & MANGANELLI (1999) with shell very variable in shape, glossy and yellowish to pale brownish or greenish yellow, with about 5-6 regularly growing whorls. *O. meridionalis* can only be identified by anatomical characters: penis without clear distinction into proximal and distal parts ("bottle-neck" portion of proximal penis absent) (1), and distinctive internal ornamentation of penis and flagellum (5-6 to 13-15 longitudinal pleats, usually straight, sometimes wavy or lobate except around epiphallus opening into penis where there is a system of small pleats, radially disposed, sometimes fragmented into rows of variably large papillae) (2).

## DESCRIPTION

Body slate blue in colour; neck and upper part of sides with variably wide areas with pits (with phylacites); foot slender, of aulacopod type, pale slate-gray, with sole longitudinally tripartite; kidney sigmurethrous; jaw oxygnathous. This species may emit a garlic-like smell when disturbed.

Shell (Figs. 1-8, Table 1; GIUSTI, 1969a: 367, Pl. 1, figs. 1-2 [*Oxychilus (Ortizius) tongiorgii*]; 369, Pl. 1, figs. 3-4 [*Oxychilus (Ortizius) forcartianus*]; GIUSTI, 1969b: 375, Pl. 1, figs. 1-3 [*Oxychilus (Ortizius) alliarius*]) dextral, small to medium in size,



Figs. 3-4. Shells of *Oxychilus meridionalis* (Paulucci, 1881) from Grotta dei Fiorentini (Castelnuovo Val di Cecina, PI), 32TPN5891, A. Sassi leg. 16.9.66 (holotype of *Oxychilus forcartianus* Giusti, 1969a; Giusti collection; Fig. 3) and Buca dei Ladri 262 T/PI (San Giuliano Terme, PI), 32TPP14, P. Tongiorgi & M. Riccucci leg. 15.7.67 (holotype of *Oxychilus tongiorgii* Giusti, 1969a; Fig. 4)

discoidal, usually tectiform, sometimes depressed, round below, thin, subtransparent, variably glossy, yellowish to pale brownish-yellow or greenish in colour, sometimes with paler spiral bands or lines and opalescent below; surface rather smooth, with variably evident growth lines and microsculpture consisting of very fine wavy spiral lines; spire of 4 3/4 - 6 1/12 whorls, rather slowly and regularly increasing in size, last whorl dilated near aperture, its last quarter descending to some extent, rarely slightly angled at periphery; sutures shallow; umbilicus small, wide about 1.3 - 3.0 mm (usually 1/6 - 1/7, rarely 1/4 - 1/5 and in only one case 1/9 of maximum shell diameter), sometimes eccentric; aperture oval, oblique; peristome interrupted, simple,

not thickened nor reflected, its superior vertex starting at or slightly above periphery of last whorl.

Dimensions (65 shells measured). Number of whorls: 5 3/7 ± 2/7 (4 3/4 - 6 1/12); shell diameter: 13.1 ± 2.0 mm (8.9 - 16.6); height: 5.5 ± 0.8 mm (3.6 - 7.4); umbilicus diameter: 2.2 ± 0.4 mm (1.3 - 3.0).

Genitalia (Figs. 9-31, Tables 2-3; GIUSTI, 1969a; Fig. 1 [Oxychilus (Ortizius) tongiorgii], Fig. 3 [Oxychilus (Ortizius) forcartianus]; GIUSTI, 1969b; Fig. 1 [Oxychilus (Ortizius) alliarius]).

General scheme of genitalia as in *Oxychilus* (s.str.) sensu GIUSTI & MANGANELLI (1999). Only distal genitalia are described here. Female genitalia include free oviduct, bursa copulatrix



and its duct, and vagina. Distal portion of duct of bursa copulatrix and of free oviduct and proximal 1/4 - 1/3 of vagina enveloped by variably large and long muff of spongy glandular tissue forming vaginal gland; duct of bursa copulatrix variably long (2.3 - 6.3 mm; n: 26), initially moderately flared, narrowing before entering oval or pyriform bursa copulatrix; distal vagina (that without glandular muff) variably long (1.1 - 4.0 mm; n: 26) and wide, not or slightly reducing in calibre near genital atrium.

Male distal genitalia include vas deferens, epiphallus and penial complex (flagellum and penis). Epiphallus variably long (3.7 - 7.8 mm; n: 26) and slender, internal walls bearing series of very slender longitudinal pleats. Flagellum rather short (1.0

- 2.8 mm; n: 26), with penial retractor muscle ending at apex. Penis variably long (4.1 - 11.6 mm; n: 26) without clear distinction into proximal and distal parts on the outside or inside. "Bottle-neck" (terminal, very slender part of proximal penis, enveloped by thin, distinct, subtransparent sheath, immediately preceding distal penis in some *Oxychilus* s.str. species; see GIUSTI & MANGANELLI, 1997; MANGANELLI & GIUSTI, 1998) absent; only in few cases, border between proximal and distal penis indicated externally by indistinct constriction and thin sheath. Internal pleats of "proximal" penis continuous with those of distal penis without interruption (point at which distal penis begins is sometimes marked by fact that pleats become wider and have more jagged sides). Penis usually wider at its beginning (level with beginning of proximal penis), then slightly reduced in caliber (level with end of proximal penis). Internal surface of flagellum and proximal penis surrounding opening of epiphallus into penis with small, radially disposed pleats, sometimes fragmented into rows of variably large papilla-like structures; surface opposite opening of epiphallus into penis with slender longitudinal pleats, usually straight, sometimes wavy, with jagged sides or lobate as if derived from row of fused papillae. Variable number (5-6 to 13-15) of these pleats continue on remaining proximal penis, converging, fusing and reducing in number before continuing without interruption inside distal penis, where they usually become wider and have jagged sides. Distal penis enveloped by rather short (0.8 - 2.9 mm; n: 26) penial sheath, initially very thin, traversed on one side by vas deferens, then slightly thickened for rest of length. Very short, thin walled duct connects distal penis (level with where penial sheath originates) to genital atrium in which vagina also ends.

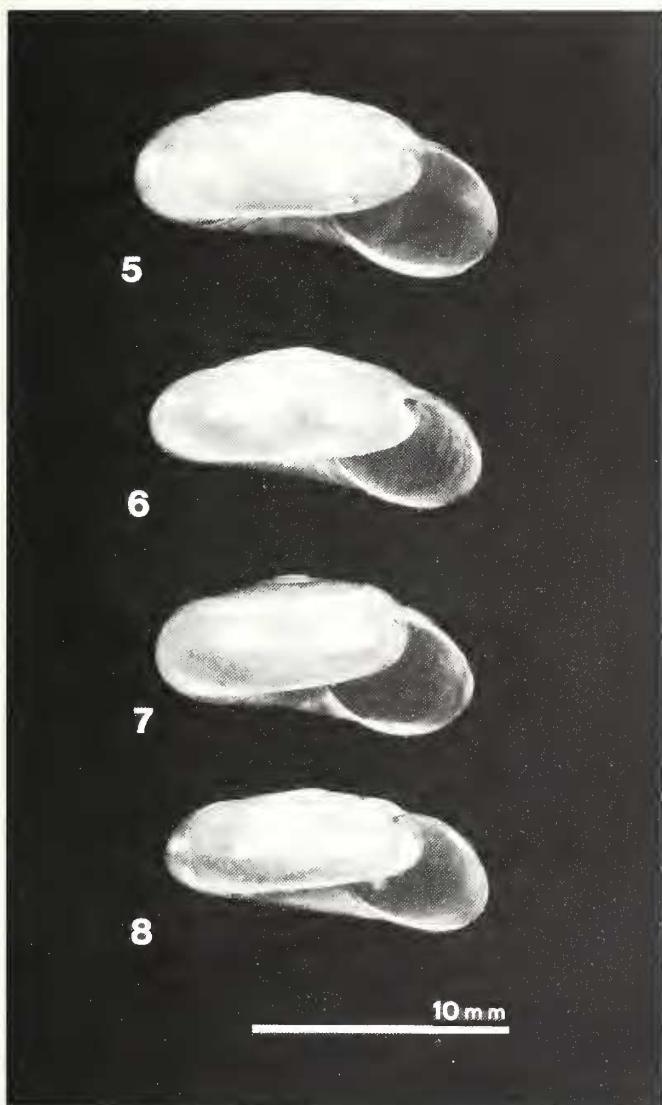
Radula (GIUSTI, 1969a: Fig. 2 [*Oxychilus (Ortizius) tongjorgii*], Fig. 4 [*Oxychilus (Ortizius) forcarius*]; GIUSTI, 1969b: Fig. 2 [*Oxychilus (Ortizius) alliarinus*]) consisting of many rows of about 29-35 teeth, according to the formula: 11-14 M/1 + 0-1 LM/2 + 2-3 L/3 + C/3 + 2-3 L/3 + 0-1 LM/2 + 11-14 M/1. Central teeth with well developed basal plate, apical portion of which V-like, with pointed vertices; body of tooth wide, providing base for long, slender, pointed mesocone flanked by two very short ectocones. On both sides of each central tooth two-three lateral tricuspid teeth, sometimes one latero-marginal bicuspis tooth and series of monocuspis marginal teeth in decreasing order of size.

## TYPE MATERIAL AND TYPE LOCALITIES

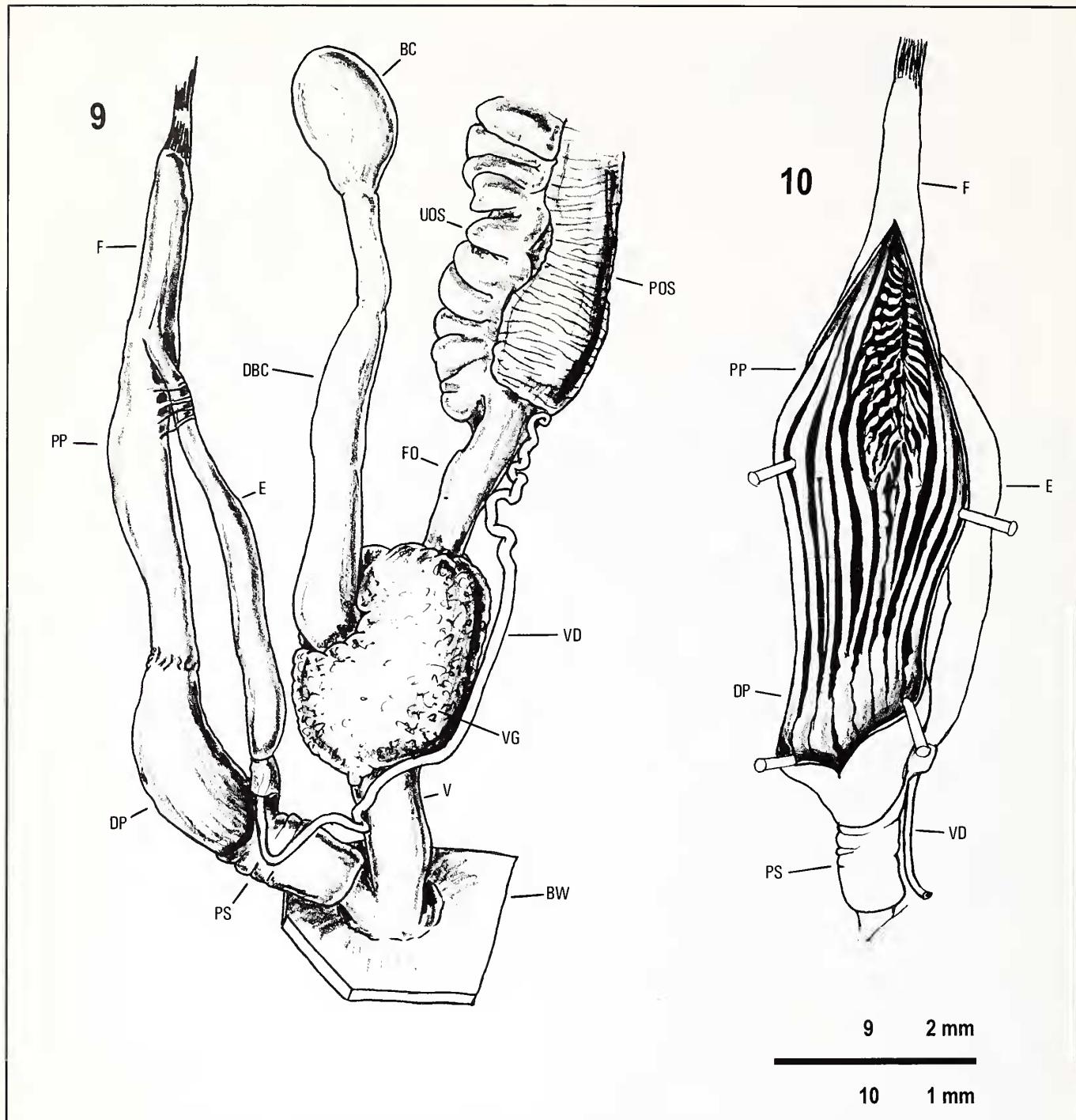
Most information about the type material and type localities of the nominal taxa is given under the synonymy. It is interesting to remark that the type localities of *Hyalinia meridionalis* and *H. isseliana* coincide. A detailed description of the place where these materials, first determined as *H. obscurata*, were found is given by PAULUCCI (1878).

## MATERIAL EXAMINED

All the material belongs to populations anatomically determined. The material examined is listed as follows: locality, municipality and province names in parenthesis, UTM referen-



Figs. 5-8. Shells of *Oxychilus meridionalis* (Paulucci, 1881) from Torrente Arbia, Balze di Caspreno (Castelnuovo Berardenga, SI), 32TPP9601, G. Manganelli leg. 8.4.82 (Fig. 5), Pastine di Sotto (Siena, SI), 32TPN8198, L. Favilli leg. 15.2.90 (Fig. 6), Torrente Arbia, Taverne d'Arbia (Siena, SI), 32TPN9496, G. Manganelli leg. 30.1.82 (Fig. 7) and Alpi Apuane, Monte Altissimo, q. 1100-1200 m (Stazzema, LU), 32TNP97, F. Giusti leg. 26.9.69 (Fig. 8).

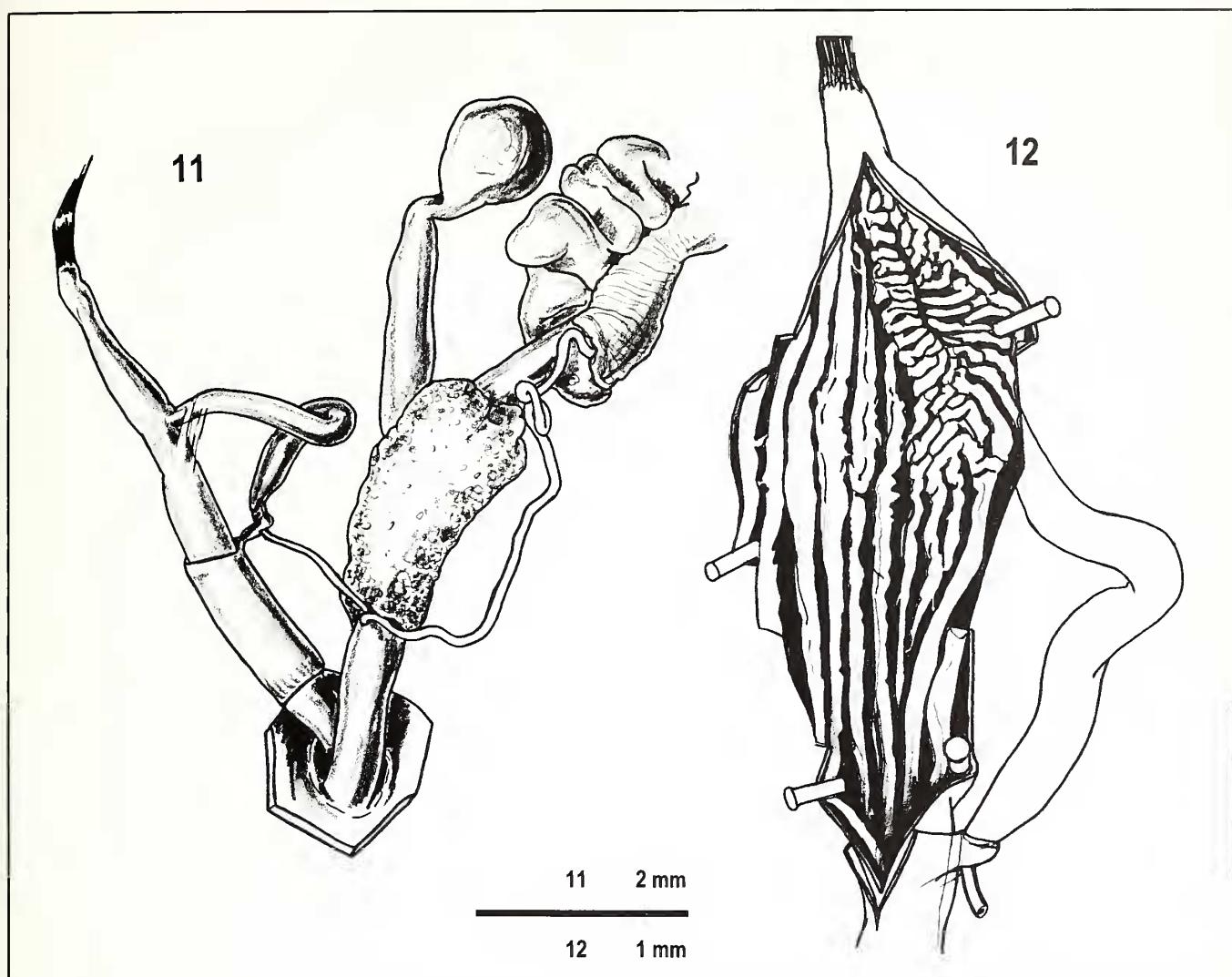


Figs. 9-10. Distal genitalia (Fig. 9) and internal ornamentation of flagellum and proximal penis (Fig. 10) in a specimen of *Oxybulus meridionalis* (Paulucci, 1881) from Fabbriche di Bagni di Lucca, along Borro Legara (Bagni di Lucca, LU), 32TPP3175, S. Cianfanelli & G. Manganelli leg. 31.10.98.  
Key to the acronyms used in Figs. 10-31: BC bursa copulatrix, BW body wall, DBC duct of bursa copulatrix, DP distal portion of penis, E epiphallus, FO free oviduct, P penis, POS prostatic portion of ovispermiduct, PP proximal portion of penis, PR penial retractor, PS penial sheath, UOS uterine portion of ovispermiduct, VD vas deferens, VG vaginal gland.

ce, collector(s), date, number of specimens (if the material has been sorted) and bibliographical reference, in parenthesis if they are voucher specimens. Locality names and UTM references are according to the official 1:25,000 scale map of Italy (series M 891). Unless otherwise indicated, all the material examined is kept in the Giusti Collection (Dipartimento di Biologia Evolu-

tiva, Via Mattioli 4, I-53100 Siena, Italy).

Acronyms. Collectors: AA A. Arrighi, AB A. Baldan, AS A. Sassi, BL B. Lanza, BS B. Sabelli, CV C. Volpi, FG F. Giusti, GC G. Comotti, GL G. Lazzari, GLr G. Lazzeroni, GM G. Manganelli, GS G. Sammuri, IS I. Scali, LB L. Borri, LBg L. Briganti, LF L. Favilli, LFr L. Forcart, MB M. Bodon,



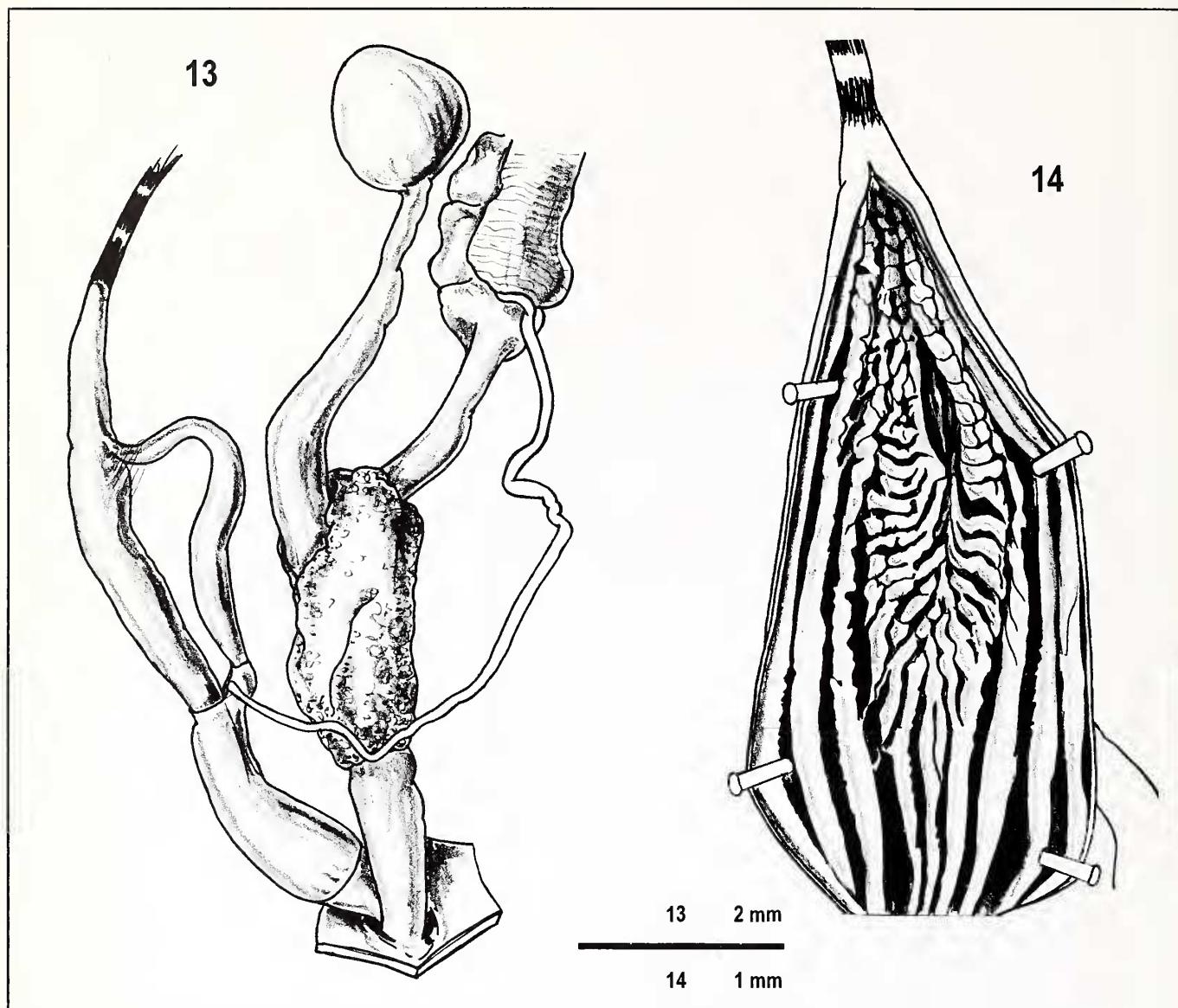
Figs. 11-12. Distal genitalia (Fig. 11) and internal ornamentation of flagellum and proximal penis (Fig. 12) in a specimen of *Oxychilus meridionalis* (Paulucci, 1881) from Bagni di Lucca (Bagni di Lucca, LU), 32TPP2574, B. Sabelli leg. 4.2.76.

MC M. Calcagno, MP M. Paulucci, MR M. Riccucci, PT P. Tongiorgi, SC S. Cianfanelli, SZ S. Zolia. Provinces: GR Grosseto, LU Lucca, MS Massa Carrara, PI Pisa, SI Siena, SP La Spezia. Materials: sh shell/s, sp spirit specimen/s. Museum and private collections: MBC M. Bodon collection, via delle Eriechi 100/8, 14148 Genova, Italy, MZUF Museo Zoologico "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze, Via Romana 17, 50125 Firenze, Italy, NMB Naturhistorisches Museum Basel, SCC S. Cianfanelli collection, P.le Porta Romana 13, 50125 Firenze, Italy.

**Liguria:** NP78) Casamatta di Monte Branzi 519 Li/Sp (Lerici, SP), 32TNP7481, LBg & SZ leg. 5.11.79 (3 sp).

**Tuscany:** NP89) Olivola (Aulla, MS), 32TNP8197, LF leg. 24.5.48 (1 sp, NMB 5894-a; FORCART, 1967, 1968, as *Oxychilus obscuratus*). NP97) Alpi Apuane, Monte Altissimo, q.

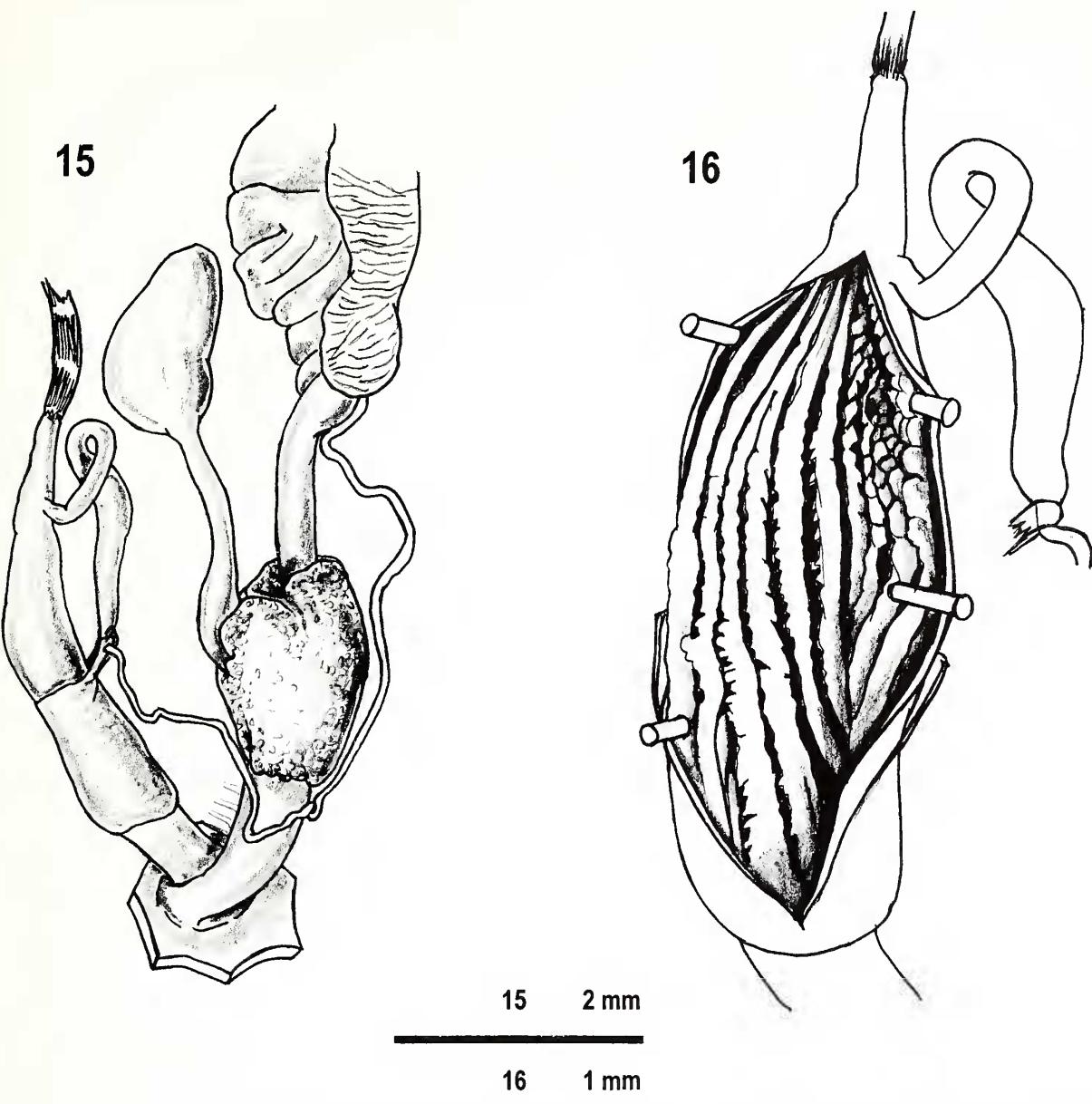
1100-1200 m (Stazzema, LU), 32TNP97, FG leg. 26.9.69 (3 sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Altissimo, q. 1300 m (Stazzema, LU), 32TNP97, FG leg. 26.9.69 (1 sh, 1 sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Altissimo, q. 1400-1500 m (Stazzema, LU), 32TNP97, FG leg. 26.9.69 (1 sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). NP98) Alpi Apuane, Bedizzano (Massa Carrara, MS), 32TNP9081, IS leg. 11.89 (5 sp). PN56 Buca del Frate di Perolla 489 T/GR (Massa Marittima, GR), 32TPN5967, GS & LB leg. 4.4.76 (1 sp). PN59 Grotta dei Fiorentini (Castelnuovo Val di Cecina, PI), 32TPN5891, AS leg. 16.9.66 (holotype [sh and genital duct] and 3 paratypes [1 sh, 2 sp] of *Oxychilus forcrtianus* Giusti, 1969a). PN89 Pastine di Sotto (Siena, SI), 32TPN8198, LF leg. 27.1.90 (2 sh), LF leg. 15.2.90 (2 sp).



Figs. 13-14. Distal genitalia (Fig. 13) and internal ornamentation of flagellum and proximal penis (Fig. 14) in a specimen of *Oxychilus meridionalis* (Paulucci, 1881) from Bagni di Lucca (Bagni di Lucca, LU), 32TPP2574, B. Sabelli leg. 28.3.74.

PN99 Torrente Arbia, Taverne d'Arbia (Siena, SI), 32TPN9496, GM leg. 30.1.82 (4 sp), GM leg. 12.3.82 (1 sp).  
PP04 Tenuta di San Rossore, Gombo (Pisa, PI), 32TPP0341, FG & GM leg. 22.12.82 (numerous sh, numerous sp). PP05 Torre del Lago Puccini (Viareggio, LU), 32TPP0453, MB, leg. 8.3.80 (1 sp). PP06 Montramito (Massarosa, LU), 32TPP0460, MB, leg. 8.3.80 (1 sp, MBC). PP07 Alpi Apuane, Grotta della Risvolta 158T/LU (Stazzema, LU), 32TPP0372, MB & SC leg. 9.11.97 (5 sp, SCC). Alpi Apuane, Levigliani (Stazzema, LU), 32TPP0275, FG leg. 23.3.70 (1 sh, numerous sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*), FG leg. 23.10.80 (2 sh, 2 sp), FG & GM, leg. 28.6.83 (5 sh, 2 sp). Alpi Apuane, Monte Forato, q. 450 m (Stazzema, LU), 32TPP07, FG leg. 16.6.70 (5 sh, numerous sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Forato, q. 700 m (Stazzema, LU), 32TPP07, FG leg. 16.6.70 (numerous sh, numerous sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Freddone, q. 800 m (Stazzema, LU), 32TPP07, FG leg. 29.10.69 (1 sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Freddone, q. 1000 m (Stazzema, LU), 32TPP07, GLr leg. 29.10.69 (numerous sh, numerous sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Pania della Croce, q. 1100 m (Stazzema, LU), 32TPP07, FG leg. 24.9.69 (3 sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. draparnaudi*). Alpi Apuane, Monte Pania della Croce, q. 1200 m (Stazzema, LU), 32TPP07, FG leg. 24.9.69 (1 sh, 4 sp). Alpi Apuane, Monte Pania della Croce, q. 1850 m (Stazzema, LU), 32TPP07, FG leg. 24.9.69 (1 sh, 4 sp).

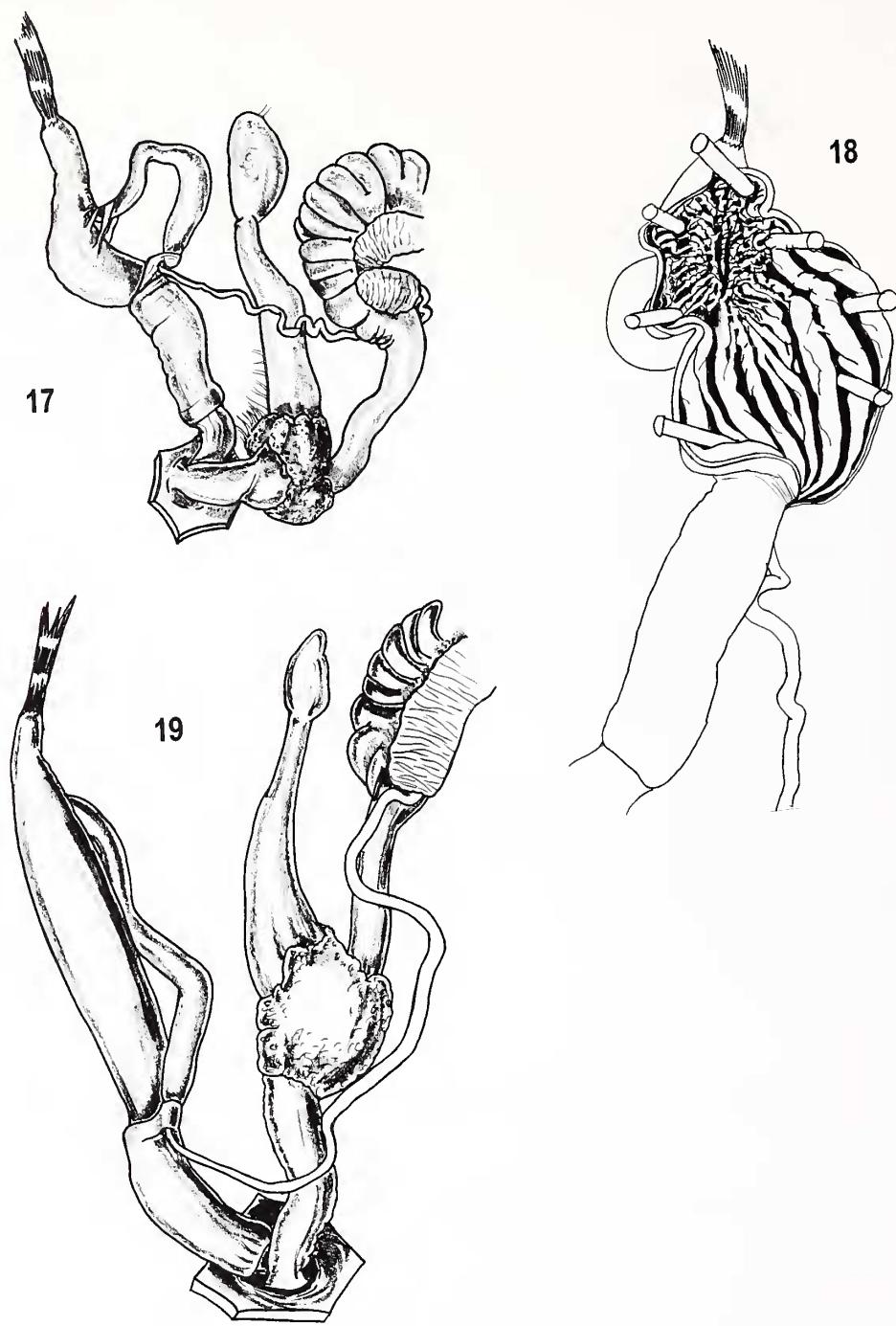
ZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Forato, q. 700 m (Stazzema, LU), 32TPP07, FG leg. 16.6.70 (numerous sh, numerous sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Freddone, q. 800 m (Stazzema, LU), 32TPP07, FG leg. 29.10.69 (1 sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Freddone, q. 1000 m (Stazzema, LU), 32TPP07, GLr leg. 29.10.69 (numerous sh, numerous sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). Alpi Apuane, Monte Pania della Croce, q. 1100 m (Stazzema, LU), 32TPP07, FG leg. 24.9.69 (3 sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. draparnaudi*). Alpi Apuane, Monte Pania della Croce, q. 1200 m (Stazzema, LU), 32TPP07, FG leg. 24.9.69 (1 sh, 4 sp). Alpi Apuane, Monte Pania della Croce, q. 1850 m (Stazzema, LU), 32TPP07, FG leg. 24.9.69 (1 sh, 4 sp).



Figs. 15-16. Distal genitalia (Fig. 15) and internal ornamentation of flagellum and proximal penis (Fig. 16) in a specimen of *Oxychilus meridionalis* (Paulucci, 1881) from Buca dei Ladri 262 T/PI (San Giuliano Terme, PI), 32TPP14, P. Tongiorgi & M. Riccucci leg. 15.7.67 (paratype of *Oxychilus tongiorgii* Giusti, 1969a).

32TPP07, FG leg. 24.9.69 (1 sp). Alpi Apuane, Rifugio Forte dei Marmi (Stazzema, LU), 32TPP0772, IS leg. 13.5.90 (1 sp). Alpi Apuane, Tanella del Cipollaio 223T/LU (Seravezza, LU), 32TPP0178, BL 23.7.61 (1 sp, MZUF no number; Forcart, 1967, 1968, as *Oxychilus porro*; 4 sh, MZUF 697; Forcart, 1968, as *Oxychilus meridionalis*), BL leg. 7.8.96 (2 sp, MZUF 15857). PP08 Alpi Apuane, cima del Monte Fiocca (Vagli, LU), 32TPP08, FG leg. 9.70 (1 sp; GIUSTI & MAZZINI, 1971, as *Oxychilus cf. meridionalis*). PP14 Buca dei Ladri 262 T/PI (San Giuliano Terme, PI), 32TPP14, PT & MR leg. 15.7.67 (holotype [sh and genital duct] and 9 paratypes [2 sh, 7 sp] of *Oxychilus*

*tongiorgii* Giusti, 1969a), MR leg. 30.11.69 (5 sh). Grotta delle Fate di Cima la Sugheretta (San Giuliano Terme, PI), GC & AB leg. 11.7.85 (numerous sp). PP15 Grotta di Parignana 69 T/PI (San Giuliano Terme, PI), GC & AB leg. 15.7.85 (numerous sh, 5 sp). Tana del Paduletto 243-244 T/PI (Vecchiano, PI), 32TPP1150, MB leg. 27.12.82 (3 sp). PP17 Fabbriche di Vallico (Fabbriche di Vallico, LU), 32TPP1472, MB, leg. 6.5.80 (1 sp, MBC). PP19 Sassorosso (Villa Collemandina, LU), 32TPP19, MB, leg. 6.5.80 (3 sh, 1 sp, MBC). PP27 Bagni di Lucca (Bagni di Lucca, LU), 32TPP2574, BS leg. 12.4.73 (3 sp; SABELLI *et al.*, 1977, as *Oxychilus* (cfr.) *uzzielli*



Figs. 17-19. Distal genitalia (Figs. 17, 19) and internal ornamentation of flagellum and proximal penis (Fig. 18) in specimens of *Oxychilus meridionalis* (Paulucci, 1881) from Grotta dei Fiorentini (Castelnuovo Val di Cecina, PI), 32TPN5891, A. Sassi leg. 16.9.66 (paratype of *Oxychilus forcitarianus* Giusti, 1969a) (Figs. 17-18) and Poggio del Comune (San Gimignano, SI), 32TPP6113, G. Manganelli leg. 7.10.82 (Fig. 19).

[sic]), BS leg. 28.3.74 (1 sp; SABELLI *et al.*, 1977, as *Oxychilus* (cfr.) *uzzielli* [sic]), BS leg. 4.2.76 (5 sp; SABELLI *et al.*, 1977, as *Oxychilus* (cfr.) *uzzielli* [sic]). Bagni di Lucca, Ponte del Diavolo (Bagni di Lucca, LU), 32TPP2674, BS leg. 10.11.72 (3 sp; SABELLI *et al.*, 1977, as *Oxychilus* (cfr.) *uzzielli* [sic]). PP37 Fabbriche di Bagni di Lucca (Bagni di Lucca, LU), 32TPP3175,

MP leg. 9.1877 (6 sh [lectotype of *Hyalinia meridionalis* Paulucci, 1881; Paulucci collection, Museo Zoologico "La Specola", Sezione del Museo di Storia Naturale dell'Università di Firenze, MZUF no. 13187; lectotype and four paralectotypes of *Hyalinia isseliana* Paulucci, 1882; Paulucci collection, Museo Zoologico "La Specola", Sezione del Museo di Storia Naturale dell'Univers-



Locality	SD	H	UD	WN	N
Alpi Apuane, Monte Altissimo, q. 1100-1200 m, F. Giusti leg. 26.9.69	11.3	4.6	2.1	5 1/8	1
Alpi Apuane, Monte Altissimo, q. 1400-1500 m, F. Giusti leg. 26.9.69	16.3	6.5	2.9	5 2/3	1
Tenuta di San Rossore, Gombo, F. Giusti & G. Manganelli leg. 22.12.82	12.3 ± 1.2 (10.8 – 14.3)	5.4 ± 0.5 (4.8 – 6.2)	2.0 ± 0.3 (1.5 – 2.4)	5 1/3 ± 1/5 (5 1/12 – 5 2/3)	10
Alpi Apuane, Levigliani, F. Giusti leg. 23.10.80	14.7 – 16.5	5.9 – 6.3	2.2 – 2.8	5 7/8 – 6	3
Alpi Apuane, Levigliani, F. Giusti & G. Manganelli, leg. 28.6.83	15.8 ± 0.7 (15.0 – 16.6)	6.2 ± 0.3 (6.0 – 6.6)	2.2 ± 0.4 (1.8 – 2.6)	5 2/3 ± 2/7 (5 1/4 – 5 7/8)	4
Alpi Apuane, Monte Forato, q. 450, F. Giusti leg. 16.6.70	13.6 ± 1.7 (12.4 – 16.6)	5.3 ± 0.5 (4.5 – 5.9)	2.3 ± 0.2 (2.0 – 2.5)	5 1/12 ± 1/9 (5 1/3 – 5 5/8)	5
Alpi Apuane, Monte Forato, q. 700 m, F. Giusti leg. 16.6.70	13.4 ± 0.6 (12.8 – 14.0)	5.3 ± 0.3 (4.9 – 5.6)	2.3 ± 0.4 (2.1 – 2.8)	5 5/8 ± 2/9 (5 3/8 – 5 7/8)	4
Alpi Apuane, Monte Pania della Croce, q. 1100 m, F. Giusti leg. 24.9.69	9.0 – 9.1	3.6 – 3.8	1.3 – 1.4	5 1/12 – 5 1/6	3
Bagni di Lucca, Ponte del Diavolo, B. Sabelli leg. 10.11.72	11.4 – 12.1	4.6 – 5.1	1.9 – 2.1	5 3/8	2
Bagni di Lucca, B. Sabelli leg. 28.3.74	16.6	6.6	3.0	5 3/4	1
Bagni di Lucca, B. Sabelli leg. 4.2.76	13.2 ± 1.8 (11.9 – 15.6)	4.8 ± 0.4 (4.3 – 5.4)	2.1 ± 0.4 (1.8 – 2.6)	5 1/17 ± 1/6 (5 – 5 3/8)	4
Bagni di Lucca, B. Sabelli leg. 12.4.73	13.0 – 16.0	4.8 – 6.1	1.9 – 2.1	5 1/8 – 5 3/4	2
Fabbriche di Bagni di Lucca, along Borro Legara, S. Cianfanelli & G. Manganelli leg. 31.10.98	15.5 ± 0.7 (14.4 – 16.1)	6.0 ± 0.9 (5.3 – 7.4)	2.5 ± 0.1 (2.4 – 2.8)	5 2/5 ± 2/5 (5 1/12 – 6 1/12)	5
Poggio del Comune, G. Manganelli leg. 7.10.82	13.1 ± 1.2 (11.9 – 14.7)	6.2 ± 0.4 (5.8 – 6.8)	2.4 ± 0.3 (2.1 – 2.8)	5 1/2 ± 1/4 (5 3/4 – 5 7/8)	7
Capanno, G. Manganelli leg. 25.4.83	12.5 ± 1.1 (10.6 – 14.1)	5.5 ± 0.7 (4.8 – 7.0)	2.3 ± 0.7 (4.8 – 7.0)	5 1/4 ± 1/5 (5 1/8 – 5 5/6)	10
Passo La Calla, F. Giusti leg. 22.6.68	9.3 – 11.0 13 ± 2.0 (8.9 – 16.6)	4.2 – 5.4 5.5 ± 0.8 (3.6 – 7.4)	1.9 – 2.3 2.2 ± 0.4 (1.3 – 3.0)	4 3/4 – 5 1/2 5 3/7 ± 1/12 (4 3/4 – 6 1/12)	3 65
All the specimens					

Table 1. Dimensions and number of whorls of shell of *Oxychilus meridionalis* (Paulucci, 1881) (mean, standard deviation above and range below). For details of localities, see Material examined. SD shell diameter, H shell height, UD umbilicus diameter, WN whorl number, N number of specimens.

sità di Firenze, MZUF no. 687, 688, 13346]; PAULUCCI, 1878, 1881, 1882, Fabbriche di Bagni di Lucca, along Borro Legara (Bagni di Lucca, LU), 32TPP3175, SC & GM leg. 31.10.98 (7 sh, 5 sp). PP61 Montauto (San Gimignano, SI), 32TPP6611, GM leg. 28.12.83 (1 sp). Poggio del Comune (San Gimignano, SI), 32TPP6113, GM leg. 7.10.82 (numerous sh, 4 sp). PP90 Capanno (Castelnuovo Berardenga, SI), 32TPP9308, GM leg. 25.4.83 (5 sp). Torrente Arbia, Balze di Caspreno (Castelnuovo Berardenga, SI), 32TPP9601, GM leg. 8.4.82 (1 sp), GM leg. 28.2.86 (2 sp), GM leg. 11.88 (1 sp). QP05 Torrente Usciolì (Pontassieve, FI), 32TQP0059, SC, MC, CV & AA leg. 11.4.99 (2 sp; SCC). QP25 Sacro Eremo di Camaldoli (Poppi, AR), 32TQP2654, GM & LF leg. 15.7.90 (1 sh, 3 sp). Poggio di Pian Tombesi, q. 1520 m (Pratovecchio, AR), GL leg. 10.9.87 (1 sp). QP26 Passo La Calla (Stia, AR), 32TQP2060, FG leg. 22.6.68 (numerous sh, numerous sp; GIUSTI, 1969b, *Oxychilus alliarinus*), FG leg. 19.6.71 (5 sh, 2 sp).

## ETYMOLOGY

PAULUCCI (1881) did not explain why she named her species "*meridionalis*" (i.e. "southern"). However the name presumably

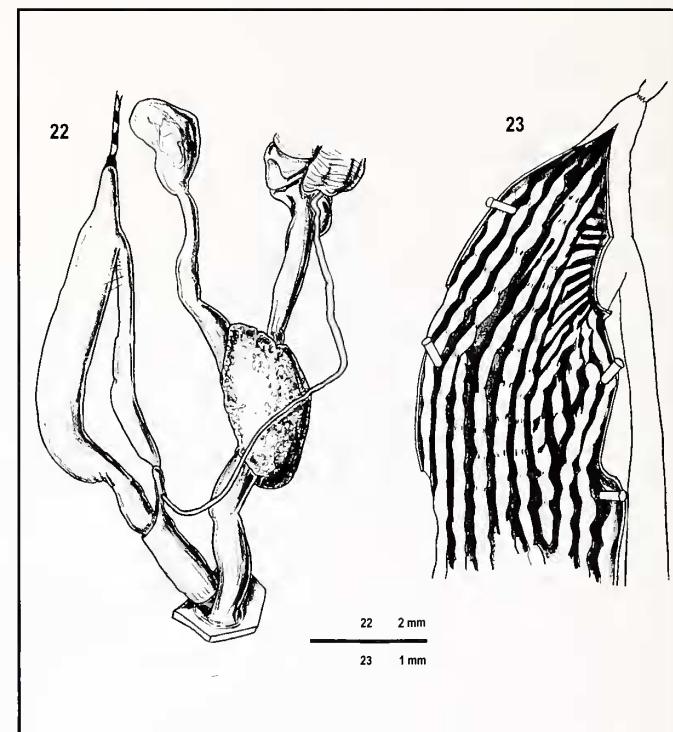
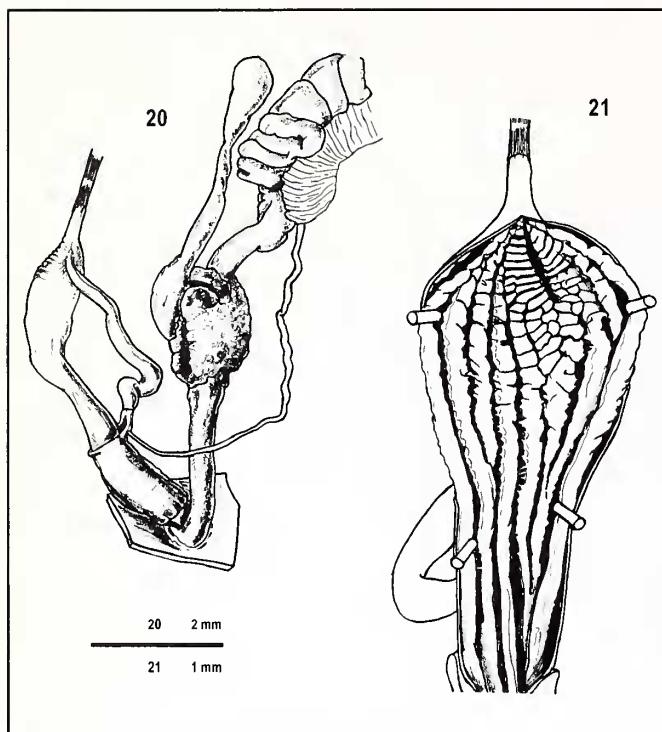
indicated that the species, as conceived by Paulucci, was widespread in central and southern Italy (PAULUCCI, 1882: 166).

The other species described by Paulucci, *Hyalinia isseliana*, was named after Arturo Issel (1842-1922), a well-known Italian geologist who had an interest in malacology (SACCO, 1923; PRINCIPI, 1924).

The two species described by GIUSTI (1969) were named after Paolo Tongiorgi and Lothar Forcart respectively. Paolo Tongiorgi is professor of Ethology at the University of Modena (Italy). His main topics of research are orientation and migration in coastal arthropods, chemoreception in *Anguilla anguilla*, behaviour of *Marmota marmota*, taxonomy of Aracnida and Gastrotricha. Lothar Forcart (1902-1990) from Basel (Switzerland) was a leading malacologist who published important contributions on the systematics of Palaearctic gastropods (VERDCOURT, 1991; WÜTHRICH *et al.*, 1993).

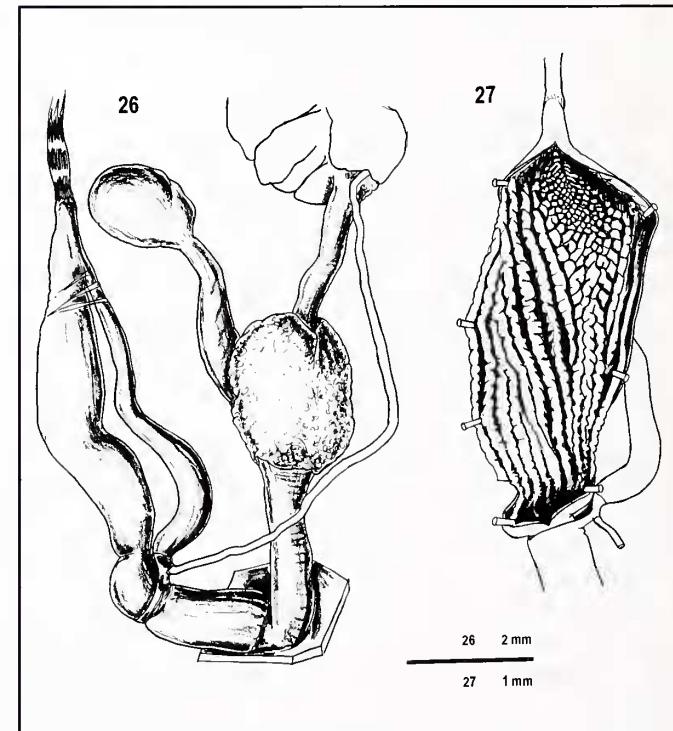
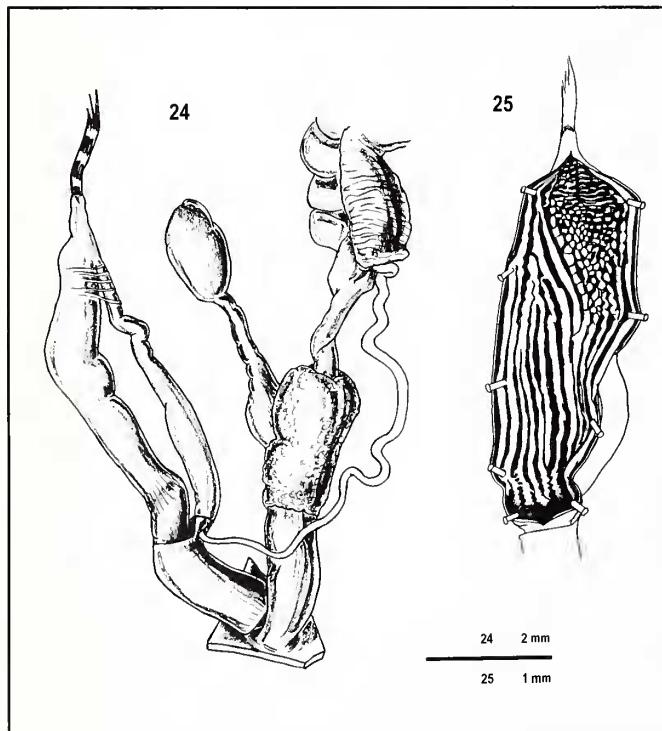
## NOMENCLATURE

Many other nominal taxa have been introduced for Tuscan *Oxychilus*, but only one is older than *O. meridionalis*, and described on specimens collected within the area of distribution of this



Figs. 20-21. Distal genitalia (Fig. 20) and internal ornamentation of flagellum and proximal penis (Fig. 21) in a specimen of *Oxychilus meridionalis* (Paulucci, 1881) from Tenuta di San Rossore, Gombo (Pisa, PI), 32TPP0341, F. Giusti & G. Manganelli leg. 22.12.82.

Figs. 22-23. Distal genitalia (Fig. 22) and internal ornamentation of flagellum and proximal penis (Fig. 23) in a specimen of *Oxychilus meridionalis* (Paulucci, 1881) from Alpi Apuane, Monte Forato, q. 450 m (Stazzema, LU), 32TPP07, F. Giusti leg. 16.6.70.



Figs. 24-25. Distal genitalia (Fig. 24) and internal ornamentation of flagellum and proximal penis (Fig. 25) in a specimen of *Oxychilus meridionalis* (Paulucci, 1881) from Capanno (Castelnuovo Berardenga, SI), 32TPP9308, G. Manganelli leg. 25.4.83.

Figs. 26-27. Distal genitalia (Fig. 26) and internal ornamentation of flagellum and proximal penis (Fig. 27) in a specimen of *Oxychilus meridionalis* (Paulucci, 1881) from Torrente Arbia, Taverne d'Arbia (Siena, SI), 32TPN9496, G. Manganelli leg. 30.1.82.



Locality	E	F	P	DPD	PS	FO	DBC	DV
Torrente Arbia, Taverne d'Arbia, G. Manganelli leg. 30.1.82	7.1	1.5	9.0	1.2	2.1	2.9	2.8	3.6
	7.5	1.8	10.1	1.3	2.7	2.2	3.3	3.6
	6.2	1.4	9.0	1.1	2.2	1.6	3.2	2.8
Tenuta di San Rossore, Gombo, F. Giusti & G. Manganelli leg. 22.12.82	5.8	1.4	7.5	0.9	1.2	1.9	3.3	3.4
	4.9	1.0	6.1	0.8	1.9	2.2	3.6	3.3
	5.0	1.5	7.2	0.9	1.9	1.6	3.2	2.2
	4.1	1.1	7.1	0.7	1.9	1.2	2.5	2.1
	4.7	1.2	6.9	0.9	2.1	1.9	2.8	3.1
Alpi Apuane, Levigliani (Stazzema, LU), F. Giusti & G. Manganelli, leg. 28.6.83	7.7	1.7	11.6	1.1	2.9	3.1	4.4	4.0
Alpi Apuane, Monte Forato, q. 700 m, F. Giusti leg. 16.6.70	5.1	1.5	8.9	0.8	2.0	3.3	4.1	4.0
	4.2	1.3	8.0	0.6	2.8	2.4	2.7	2.9
	5.2	1.6	7.6	0.7	1.6	2.6	3.2	2.8
	4.0	1.4	5.7	0.7	1.4	1.9	1.9	2.2
Grotta delle Fate di Cima la Sugheretta, G. Comotti & A. Baldan leg. 11.7.85	4.0	1.2	4.9	0.6	0.8	2.5	2.6	1.2
	4.5	1.1	6.1	0.7	1.3	2.3	2.9	2.4
	4.0	1.4	5.7	0.7	1.9	1.4	2.9	2.1
Bagni di Lucca, B. Sabelli leg. 4.2.76.	3.7	2.3	4.1	0.7	1.9	1.4	2.9	2.1
	5.0	2.1	6.7	1.1	2.9	2.7	5.2	2.2
	4.4	1.5	5.3	0.7	2.1	2.4	2.6	2.9
Fabbriche di Bagni di Lucca, along Borro Legara, S. Cianfanelli & G. Manganelli leg. 31.10.98.	5.3	2.7	7.2	0.7	1.1	1.8	4.4	1.1
	5.6	2.7	7.6	0.7	1.6	1.9	6.2	1.9
Montauto, G. Manganelli leg. 28.12.83	6.1	1.7	8.3	1.1	2.5	1.4	3.9	2.7
Poggio del Comune, G. Manganelli leg. 7.10.82	5.7	1.4	8.2	0.9	2.4	1.3	2.5	3.4
	6.2	1.2	8.1	0.9	2.3	1.7	3.5	2.9
Capanno G. Manganelli leg. 25.4.83	6.7	1.5	8.9	1.1	2.4	2.4	2.8	2.6
	7.4	1.7	8.9	1.1	1.2	2.5	2.2	3.4
Torrente Arbia, Balze di Caspreno, G. Manganelli leg. 8.4.82	7.7	1.9	8.9	1.3	2.2	2.1	2.3	3.3

Table 2. – Dimensions (in mm) of parts of the distal genitalia in specimens of *Oxychilus meridionalis* (Paulucci, 1881). For details of localities, see Material examined. E epiphallus, F flagellum, P penis, DPD distal penis diameter, FO free oviduct, DBC, duct of bursa copulatrix, PS penial sheath, DV distal vagina. For identification of the parts measured, see anatomical description.

Locality	Number of mid penis pleats	Number of specimens examined
Pozzo della Casamattra di Monte Branzi 519 Li/Sp, L. Briganti & S. Zoia leg. 5.11.79	5-9	1
Grotta dei Fiorentini, A. Sassi leg. 16.9.66	5-7 to 7-8	2
Torrente Arbia, Taverne d'Arbia, G. Manganelli leg. 30.1.82	12 to 14	1
Tenuta di San Rossore, Gombo, F. Giusti & G. Manganelli leg. 22.12.82	5-6 to 6-9	3
Alpi Apuane, Levigliani, F. Giusti & G. Manganelli, leg. 28.6.83	9-10	1
Alpi Apuane, Monte Forato, q. 450 m, F. Giusti leg. 16.6.70	8-9	1
Alpi Apuane, Monte Forato, q. 700 m, F. Giusti leg. 16.6.70	8	1
Buca dei Ladri 262 T/PI, P. Tongiorgi & M. Riccucci leg. 15.7.67, M. Riccucci leg. 30.11.69.	7-8 to 9	2
Grotta delle Fate di Cima la Sugheretta, G. Comotti & A. Baldan leg. 11.7.85	7-9 to 7-12	2
Bagni di Lucca, B. Sabelli leg. 12.4.73, B. Sabelli leg. 28.3.74, B. Sabelli leg. 4.2.76.	7-10 to 9-10	3
Fabbriche di Bagni di Lucca, along Borro Legara, S. Cianfanelli & G. Manganelli leg. 31.10.98.	8-10 to 8-12	2
Poggio del Comune, G. Manganelli leg. 7.10.82	11-13 to 13-15	2
Capanno G. Manganelli leg. 25.4.83	11-13	1
Passo La Calla F. Giusti leg. 22.6..	7-9 to 7-10	2

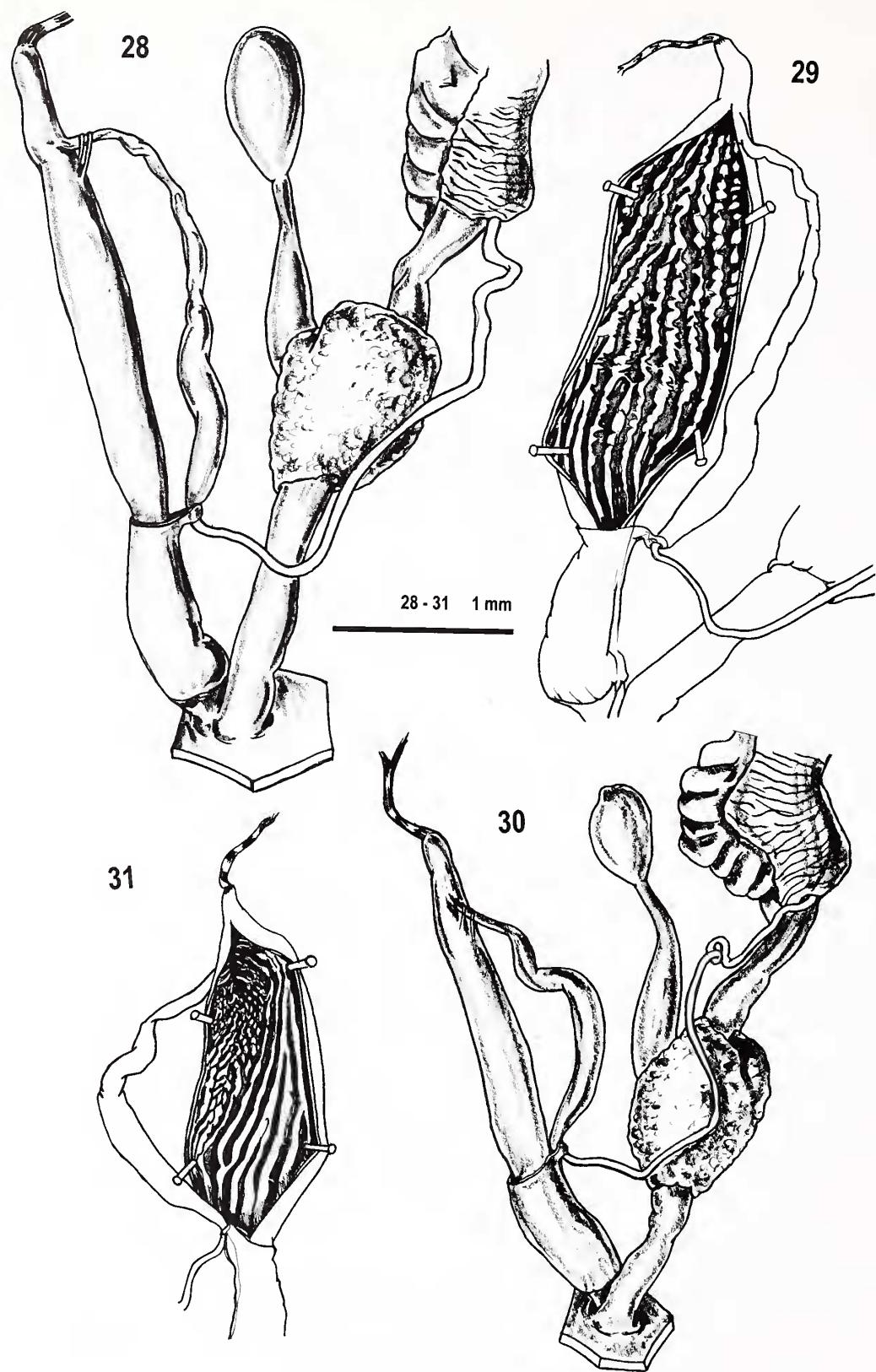
Table 3. Number of pleats in mid penis of specimens of *Oxychilus meridionalis* (Paulucci, 1881). As the pleats divide or fuse inside the mid portion of penis, the minimum and maximum number of pleats is given. For details of localities, see Material examined.

species: *Hyalina scotophila* De Stefani, 1879 (Type locality: "Siena, in profondo condotto sotterraneo"). This nominal taxon was based on three shells collected by S. Bonelli and first published by him (BONELLI, 1878, as *Hyalina aquitanica*). Type material of this species is kept in the Museo Zoologico dell'Accademia dei Fisiocritici in Siena. It consists of three not fully adult specimens of an unidentified *Oxychilus* species. Since we have only

ever collected one species in Siena, namely *O. draparnaudi* (Bech, 1837), *H. scotophila* is probably a junior synonym of the latter.

## TAXONOMY

*Oxychilus meridionalis* (Paulucci, 1881) is characterized by wide conchological and anatomical variability (Figs. 1-31; Tables 1-3). The shell diameter of sexually adult specimens



Figs. 28-31. Distal genitalia (Figs. 28, 30) and internal ornamentation of flagellum and proximal penis (Figs. 29, 31) in specimens of *Oxychilus meridionalis* (Paulucci, 1881) from Passo La Calla (Stia, AR), 32TQP2060, F. Giusti leg. 22.6.68.

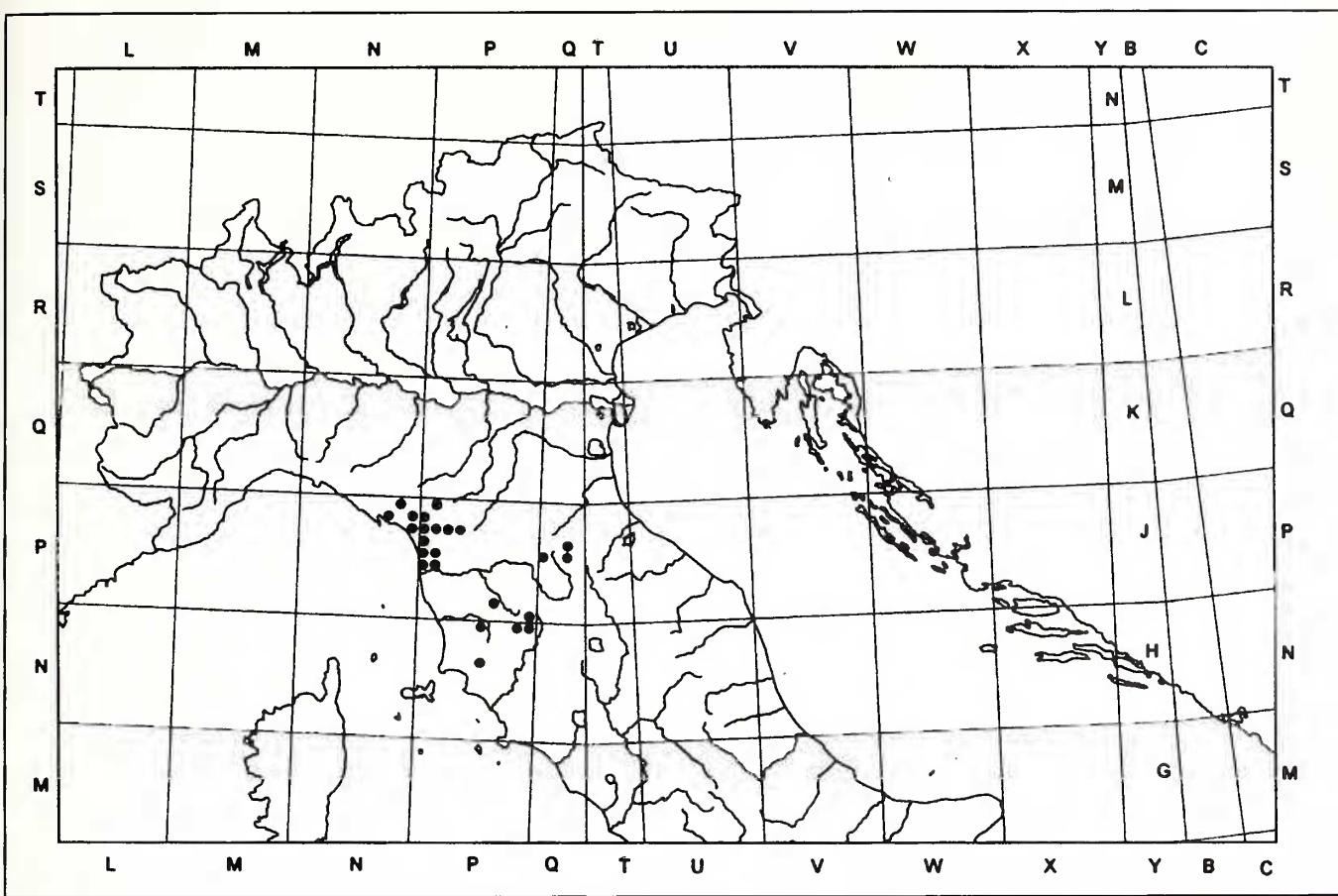


Fig. 32. The distribution of *Oxychilus meridionalis* (Paulucci, 1881) on UTM map of central-northern Italy.

varies from a minimum of 8.9 mm (Apuan Alps, Pania della Croce) to a maximum of 16.6 mm (Apuan Alps, Leviglioni and Monte Forato). Size variation is also wide within populations (10.8 to 14.3 at Gombo, n: 10; 10.6 to 14.1 at Capanno, n: 10; 11.9 to 14.1 at Poggio del Comune, n: 7) (Table 1). Shell shape is discoidal, usually tectiform, but sometimes depressed; the aperture is oval and oblique, and sometimes displaced downwards to different degrees. The internal sculpture of flagellum and penis also varies widely (especially around the epiphallus opening where the usual system of radial pleats is fragmented to a variable extent into many papillae of different size) and in the number of longitudinal pleats at mid penis (which ranges from 5-7 to 12-15). Although this variability is remarkable, it is no help for establishing divisions in the populations examined, because it is impossible to pinpoint a consistent and decisive pattern distinguishing more specific or subspecific entities.

The distinction of *O. meridionalis* from the other sympatric *Oxychilus* species is easy in the case of *O. (s.str.) clarus* (Held, 1838), *O. (Mediterranea) hydatinus* (Rossmässler, 1838) and *O. (s.str.) uziellii* (Issel, 1872), but difficult in the case of *O. (s.str.) draparnaudi* (Beck, 1837), the most widespread *Oxychilus* species

in inland Tuscany.

The medium-sized, yellowish shell immediately distinguishes *O. meridionalis* from *O. clarus* and *O. hydatinus* (the latter two are very small to small in size and with a whitish shell; KERNEY et al., 1983: Pl. 10). The shell, round below, with the last whorl dilated near aperture, sometimes slightly angled at periphery, the sutures shallow, the umbilicus slightly narrow, and the aperture oval and oblique enable most of the specimens of *O. meridionalis* to be distinguished from *O. uziellii* (shell rather flat below, with last whorl only slightly dilated, usually slightly angled at base; sutures deep; umbilicus wide, funnel-shaped, aperture subtriangular to oval, oblique, often displaced downwards; MANGANELLI & GIUSTI, 1985: Figs. 3 A-B, D-F, 4 A-D; 1993: Fig. 7; 2000: Figs. 1-5). However, smaller specimens of *O. meridionalis* with the aperture more or less displaced downwards (Fig. 8) are very reminiscent of *O. uziellii* and the conchological distinction between the two species can easily escape the untrained eye. Dubious cases of this kind can be settled by anatomical study (*O. uziellii* has a penial flagellum peculiarly developed and proximal penis very reduced; internal ornamentation of flagellum and proximal penis consists of a system of transverse pleats converging towards a longitudinal double



Species	Size range	Geographical distribution	Main references
<i>O. alliarius</i> (Miller, 1822)	5.5 – 7.0 mm (KERNEY <i>et al.</i> , 1983)	Western Palearctic	TAYLOR (1907), WÜTRICH (1963), RIEDEL (1957, 1980), GITTEMBERGER <i>et al.</i> (1984), CASTILLEJO (1985)
? <i>O. anjana</i> Altonaga, 1986	7.3 – 10.1 mm (ALTONAGA, 1986)	Northern Spain	ALTONAGA (1986, 1989)
<i>O. basajana</i> Altonaga, 1990	10.1 – 13.0 mm (ALTONAGA, 1990)	Northern Spain	ALTONAGA (1990)
<i>O. caspius</i> (Boettger, 1880)	7.0 – 9.0 mm (RIEDEL, 1996)	Northern Iran	RIEDEL (1959, 1966, 1980, 1981)
<i>O. clarus</i> (Held, 1838)	4.0 – 4.2 mm (KERNEY <i>et al.</i> , 1983)	Western Europe	FORCART (1957), RIEDEL (1980), GIUSTI <i>et al.</i> (1985), MANGANELLI & GIUSTI (1993)
<i>O. concinnus</i> (Westerlund, 1896)	not more than 8.0 mm (RIEDEL, 1966)	Northwestern Iran	RIEDEL (1966, 1980, 1981)
<i>O. courquini</i> (Bourguignat, 1870)	5.0 – 5.6 mm (RIEDEL, 1972)	Northwestern Spain (Catalonia)	RIEDEL (1972, 1980)
<i>O. decipiens</i> (Boettger, 1886)	6.5 – 10.5 mm (RIEDEL, 1966)	Northeastern Turkey and Caucasus	RIEDEL (1966, 1980)
<i>O. emmae</i> (Akramowski, 1955)	non more than 5.8 mm (RIEDEL, 1966)	Lesser Caucasus	RIEDEL (1966, 1980, 1995)
? <i>O. gardinii</i> Manganelli, Bodon & Giusti, 1991	13.0 – 16.5 mm (MANGANELLI <i>et al.</i> , 1991)	Northern Italy (Liguria)	MANGANELLI <i>et al.</i> (1991)
<i>O. helveticus</i> (Blum, 1881)	8.0 – 10.0 mm (KERNEY <i>et al.</i> , 1983)	Western Europe	RIEDEL (1957, 1964a, 1970, 1980), WÜTRICH (1963), ALTONAGA (1991)
<i>O. juvenostriatus</i> Riedel, 1964b	5.5 – 7.8 mm (RIEDEL, 1964b)	Azores (Faial I.)	RIEDEL (1964b, 1980)
<i>O. lentiformis</i> (Kobelt, 1882)	up to 13.0 mm (RIEDEL, 1969)	Baleares (Mallorca and Menorca)	RIEDEL (1969, 1980)
<i>O. lineolatus</i> Frias Martins & Ripken, 1991	7.5 – 10.6 mm (FRIAS MARTINS & RIPKEN, 1991)	Azores (Santa Maria I.)	FRIAS MARTINS & RIPKEN (1991)
<i>O. mercadali</i> Gasull, 1969	7.0 – 10.5 mm (RIEDEL, 1972)	Western Spain (Valencia)	RIEDEL (1972, 1980)
<i>O. miguelinus</i> Pfeiffer, 1856	up to 15.0 mm (RIEDEL, 1964b)	Azores	RIEDEL (1964b, 1980)
<i>O. ornatus</i> Riedel, 1964	4.7 – 5.6 mm (RIEDEL, 1964b)	Azores (I. Faial)	RIEDEL (1964b, 1980)
? <i>O. patulaeformis</i> (Boettger, 1889)	7.0 mm (RIEDEL, 1966)	Northwestern Iran	RIEDEL (1980, 1998)
<i>O. paulucciae</i> (De Stefani, 1883)	17.9 – 18.7 mm (FORCART, 1967, as <i>O. lanzae</i> )	Central Italy (Tuscany)	FORCART (1967), RIEDEL (1980), MANGANELLI <i>et al.</i> (1995)
<i>O. perspectivus</i> (Kobelt, 1881)	6.0 – 8.5 mm (GIUSTI, 1973)	Southern Italy	GIUSTI (1973), RIEDEL (1980)
<i>O. pityusanus</i> Riedel, 1969	up to 9.3 mm (RIEDEL, 1969)	Baleares (Pityuses Is.)	RIEDEL (1969, 1980)
<i>O. rateranus</i> (Servain, 1880)	10.0 – 13.0 mm (RIEDEL, 1972)	Southern Spain	RIEDEL (1972, 1980)
<i>O. scolium</i> Frias Martins, 1989	13.7 mm (FRIAS MARTINS, 1989)	Azores	FRIAS MARTINS (1989)
<i>O. subeffusus</i> (Boettger, 1879)	up to 4.7 (RIEDEL, 1966)	Northeastern Turkey and northern Iran	RIEDEL (1966, 1980), AKRAMOWSKI (1976)
<i>O. tomlinii</i> (Smith, 1905)	up to 16 mm (RIEDEL, 1966)	Southern Greece	RIEDEL (1980, 1990)
<i>O. translucidus</i> (Mortillet, 1854)	7.0 – 7.5 mm (RIEDEL, 1966, as <i>O. komarowi</i> )	? Northern Iran. Introduced in western Caucasus, Turkey, Bulgaria and Poland	RIEDEL (1966, 1980, 1989)
<i>O. tropidophorus</i> (Mabille, 1869)	19.0 – 20.0 mm (GERMAIN, 1930)	Corsica	GERMAIN (1930)
? <i>O. uziellii</i> (Issel, 1872)	9.8 – 12.5 mm (GIUSTI & MANGANELLI, 2000)	Central Italy (Tuscany and Emilia)	MANGANELLI & GIUSTI (1985, 1993, 2000)

Table 4. Species assigned to *Oxychilus (Ortizioides)* by Riedel (1980, 1998) (a question mark indicates tentative assignment).

cordon, opposite the opening of the epiphallus into the penis; MANGANELLI & GIUSTI, 1985: Figs. 1 A-D, 2 A-C; 1993: Figs. 4-5; 2000: Figs. 6-10). DE STEFANI's reports (1875, 1879, 1883-88) of *O. uziellii* from the Apuan Alps and Garfagnana were probably based on specimens of *O. meridionalis* with similar features.

No qualitative or quantitative shell character distinguishes *O. meridionalis* from *O. draparnaudi*. The garlic-like smell is the only external feature which may give some indication. Although this smell aids identification of *O. meridionalis*, its absence does not prove that the specimen belongs to *O. draparnaudi*, because it is an inconstant feature. Consequently, only anato-



mical study enables certain discrimination of the two species (in *O. draparnaudi* the proximal penis is separated from the distal portion by an abrupt constriction, a very slender twisted "bottle-neck" concealed by a thin translucent sheath, and its internal surface is covered with rows of papillae which stop before the "bottle-neck"; GIUSTI & MANGANELLI, 1997: Figs. 15-30, MANGANELLI & GIUSTI, 1998: Figs. 19-22).

*O. meridionalis* belongs to *Oxychilus* (s.str.) sensu GIUSTI & MANGANELLI (1999). In fact it shares the following characters with the *Oxychilus* (s.str.) species: penis with flagellum; penial retractor inserted at apex of flagellum; internal ornamentation of penis consisting of pleats and rows of papillae; epiphallus long, usually more than proximal penis; internal wall of the epiphallus with slender longitudinal pleats; mucous gland mainly vaginal; long mesocone of central tooth. Among the *Oxychilus* (s.str.), it shares a sac-like penis, without the evident mid-penial constriction and sheath with *O. cellararius* (Müller, 1774) and *O. pilula* (Paulucci, 1886) and the pleats inside the proximal penis with the species assigned to *Ortizius* Forcart, 1957 (type species: *Hyalina (Polita) helvetica* Blum, 1881). It is distinguished from *O. cellararius* and *O. pilula* by virtue of the internal ornamentation of penis (in the proximal penis of *O. cellararius*, there is a variable number (6-8) of rows of very few, large papillae; in the proximal penis of *O. pilula* there are 8-10 rows of numerous, polygonal or pyramidal papillae). *O. meridionalis* is also distinguished from *O. pilula* in shell shape (the shell of *O. pilula* is *Retinella*-like) (for *O. cellararius*, see GIUSTI & MANGANELLI, 1997: Figs. 3-14; for *O. pilula*, see MANGANELLI *et al.*, 1999: Figs. 19-21).

The distinction of *O. meridionalis* from many "Ortizius" species is more problematical, due to the fact that this alleged subgenus is a large assemblage of species (Table 4), many of which are relatively unknown. Among the 28 species assigned to this subgenus by RIEDEL (1980, 1998), *O. patulaformis* (Boettger, 1889) is anatomically unknown and *O. subeffusus* (Boettger, 1879) is possibly related to another subgenus, i.e. *Mediterranea* Clessin, 1880 (type species: *Helix hydatina* Rossässler, 1838) (see GIUSTI & MANGANELLI, 1999). All remaining species are known anatomically, but the internal structure of the penial complex (flagellum, proximal and distal penis) is only known in sufficient detail in six of them (*O. anjana* Altonaga, 1986, *O. basajana* Altonaga, 1990, *O. clarus* (Held, 1838), *O. gardinii* Manganelli, Bodon & Giusti, 1991, *O. lineolatus* Frias Martins & Ripken, 1991, and *O. uziellii*). The internal structure of the penis is known in three other species (*O. miguelinus* Pfeiffer, 1856, *O. perspectivus* Kobelt, 1881 and *O. translucidus* (Mortillet, 1854)), but the details of the ornamentation around the epiphallus opening are missing or unclear. The internal anatomy of the other species is relatively or completely unknown.

*O. meridionalis* is easily distinguished from many species by its larger size. Species smaller in size include some well known ones, such as the western European *O. clarus*, the European *O. alliarius* (Miller, 1822), the southern Italian *O. perspectivus* (Kobelt, 1881), and others, which are less known such as the Azorean *O. ornatus* Riedel, 1964, and *O. juvenostriatus* Riedel, 1964), the western Spanish *O. courquini* (Bourguignat, 1870),

the northern Iranian *O. translucidus* (Mortillet, 1854), the Caucasian *O. emmae* (Akramowski, 1955), and the northern Iranian *O. patulaformis* (Boettger, 1889) and *O. concinnus* (Westerlund, 1896) (Table 4). Moreover the yellowish, brownish or greenish shell distinguishes *O. meridionalis* from *O. clarus* and *O. perspectivus*, both of which have a whitish shell.

Many other species have specimens of a size which falls in the range of *O. meridionalis*, in increasing order of size: *O. caspius* (Boettger, 1880), *O. pityusamus* Riedel, 1969, *O. helveticus* (Blum, 1881), *O. anjana*, *O. decipiens* (Boettger, 1886), *O. mercadali* Gasull, 1969, *O. lineolatus*, Frias Martins & Ripken, 1991, *O. uziellii*, *O. rateranus* (Servain, 1880), *O. basajana*, *O. lentiformis* (Kobelt, 1882), *O. scoliura* Frias Martins, 1989, *O. miguelinus* Pfeiffer, 1856, *O. tomlini* (Smith, 1905), *O. gardinii* Manganelli, Bodon & Giusti, 1991. Two other species are slightly larger: *O. paulucciae* (De Stefani, 1883) and *O. tropidophorus* (Mabille, 1869) (Table 4).

The shell and anatomical characters distinguish *O. meridionalis* readily from the sympatric *O. uziellii* (see above) which is quasi-endemic to Tuscany and the anatomical characters distinguish it from the peculiar northern Spanish *O. anjana* and *O. basajana*, the Ligurian *O. gardinii* and the Azorean *O. lineolatus* (very short, inflated penial complex in *O. anjana*; internal surface of penis with many (30-35) small longitudinal pleats in *O. basajana*; very slender proximal penis in *O. gardinii*; very short penial complex in *O. lineolatus*; for *O. anjana*, see ALTONAGA, 1986: Figs. 1-19; or *O. basajana*, ALTONAGA, 1991: Figs. 2-4; for *O. gardinii*, see MANGANELLI *et al.*, 1991: Figs. 7-20; for *O. lineolatus*, see FRIAS MARTINS & RIPKEN, 1991: Fig. 5).

The usually larger discoidal, tectiform or flattened shell with a wider umbilicus and the absence of a black edge to the mantle distinguish it from the western European *O. helveticus* (Blum, 1881), the size (SD: 8.0 – 10.0 mm; KERNEY *et al.*, 1983) of which overlaps with that of the smaller specimens of *O. meridionalis* (slightly globose shell with a narrower umbilicus and black edge to the mantle in *O. helveticus*; KERNEY *et al.*, 1983: Pl. 10).

*O. meridionalis* is difficult to differentiate from the other species on the basis of the available knowledge. Some range in size from the smallest *O. meridionalis* to slightly larger. This group includes four species, all with restricted distribution: the northern Iranian *O. caspius* (Boettger, 1880), the Balearian *O. pityusamus* Riedel, 1969, the Anatolian and Caucasian *O. decipiens* (Boettger, 1886), the western Spanish *O. mercadali* Gasull, 1969. Others fall in the size range of *O. meridionalis*: the Balearean *O. lentiformis* (Kobelt, 1882), the Azorean *O. scoliura* Frias Martins, 1989 and *O. miguelinus* (Pfeiffer, 1856) and the Greek *O. tomlini* (Smith, 1905). Some of these species seem to have a longer flagellum (*O. tomlini*) and others a constriction between the proximal and distal penis (*O. decipiens* and *O. scoliura*) (for *O. decipiens*, see RIEDEL, 1966: Fig. 66; for *O. scoliura*, see FRIAS MARTINS, 1989: Figs. 17A-17B; for *O. tomlini*, see RIEDEL, 1990: Fig. 25).

Finally, two other species are larger in size than *O. meridionalis*: the Tuscan *O. lanzai* Forcart, 1967 (= *O. paulucciae* De Stefani, 1883, sensu RIEDEL, 1980), and the Corsican *O. tropidophorus*



(Mabille, 1869), both of which are in need of revision.

When FORCART (1967, 1968) began the revision of the Tuscan *Oxychilus*, he based his work on cave specimens sent to him for determination, mainly by Prof. B. Lanza of the Museo di Zoologia dell'Università di Firenze. Unfortunately he did not have topotypical specimens of the classic Tuscan taxa at his disposal and therefore based his analysis on the study of specimens with shells similar to that of the types. He studied only very few specimens anatomically and was thus unable to realize the wide conchological and anatomical variability of these entities. He therefore regarded *O. meridionalis* and *O. isselianus* as two distinct species belonging to *Oxychilus* (s.str.), based on specimens of *O. draparnaudi*, and assigned the *Ortizius*-like *Oxychilus* to different species: the small-sized, *uzziellii*-like forms to "*O. obscuratus*" (Villa & Villa, 1841), and the large forms to "*O. porroi*" (Paulucci, 1882). "*O. obscuratus*" is a nominal taxon, related to a species from Corsica, in need of revision; "*O. porroi*", described from Genoa, is a junior synonym of *O. draparnaudi* (MANGANELLI *et al.*, 1995). The two species described by GIUSTI (1969a), *O. tongiorgii* and *O. forcadianus*, are also based on specimens belonging to this species (Figs. 16-19).

## HABITAT

*Oxychilus meridionalis* is moderately calciphile and lives in litter, under stones or decaying wood, mainly in woods of deciduous mesophilous broadleafs, from sea level to 1500 m of altitude.

## GEOGRAPHICAL DISTRIBUTION

Species with reduced distribution, limited to Tuscany and eastern Liguria (the Lerici area; MANGANELLI *et al.*, 1995). In Tuscany it seems to be present in three main areas: roughly the Apuan Alps and Monte Pisano in the northwest, the Colline Metallifere, Montagnola Senese and southern Chianti in the south, and the Tuscan Apennine ridge in the northeast.

## STATUS AND CONSERVATION

Not globally threatened. *Oxychilus meridionalis* has a limited distribution, but it does not seem to be under any particular threat at present.

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